A Directory of Neotropical Wetlands

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A Directory of Neotropical Wetlands

A DIRECTORY OF NEOTROPICAL WETLANDS

Compiled by

Derek A. Scott and **Montserrat Carbonell**

for the

Canadian Wildlife Service

Ducks Unlimited, Incorporated

International Council for Bird Preservation (ICBP)

International Union for Conservation of Nature and Natural Resources (IUCN)

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FOREWORD

The remaining pristine wetlands of the world lie in the tropical and southern parts of the globe. If they are to be saved, to serve - in the words of the preamble to the Ramsar Convention - as "regulators of water regimes", as "habitats supporting a characteristic flora and fauna", and as "a resource of economic, cultural, scientific and recreational value," their situation, extent and condition must first be carefully documented. Only then can national and international plans for conservation be realistically drawn up, priorities established and strategies implemented. It is the purpose of the present Directory to lay, for the Neotropical Realm, the necessary groundwork of identification. The first such directory was the Directory of Western Palearctic Wetlands, compiled by Erik Carp for IUCN and UNEP in 1980. This helped to stress the great losses of natural wetlands that have occurred in the developed countries. A Directory of African Wetlands is nearing completion and one on Asian Wetlands has just been begun. For North America, the wetlands of Canada and the U.S.A. are being mapped in ever greater detail.

The present Directory was initiated at the IWRB meeting in Edmonton, Alberta, in 1982, attended by participants from many states in South and Central America. There it was agreed to produce a report on the current status of wetlands of the Neotropics, including the Caribbean, with particular emphasis on their avifauna and management. The data base thus established could then be continuously updated. The project was initiated in April 1983, and funding generously provided by both governmental and non-governmental bodies: Canadian Wildlife Service, Ducks Unlimited Inc., U.S. Fish and Wildlife Service, Wildfowl Foundation Inc. and World Wildlife Fund; they will, we are sure, feel they got good value for their contributions. A considerable boost to the project was given by the IWRB meeting in La Rabida, Spain, in May 1983, attended by participants from thirteen countries of the Neotropical Realm. The final text was reviewed and improved at another IWRB meeting, this time in Paracas, Peru, in February 1985, with twenty-five of the region's countries directly represented. The report of the Paracas meeting contains a discussion of the project and a preliminary analysis of some of the findings.

Although the main action has been through IWRB, close collaboration was maintained with colleagues in ICBP and IUCN and this has been a truly co-operative enterprise of these international bodies. But they could have achieved little had not so many people in so many countries made freely available their time and their records. It is a particular matter for congratulation that the co-ordinator, Derek Scott, his assistant Montse Carbonell and nearly three hundred collaborators have been able to bring together and analyse such a mass of material in just two short years. Quite apart from its intrinsic value, the preparation of the Directory has greatly stimulated the interest in and concern for the threatened wetlands of the region. It has had impact at all levels from governments to individuals.

More and more countries are adhering to the Convention on Wetlands of International Importance Especially as Waterfowl Habitat, known as the Ramsar Convention after the small town in Iran where it was initiated. Already thirty-eight countries are guiding the wise use of their wetlands under the constraints of the Convention and, in particular, have set aside for conservation 302 sites covering twenty million hectares of prime wetland. The Directory of Neotropical Wetlands has always been intended as a "shadow" list of sites eligible for designation under the Convention. It is greatly to be hoped that, as a result of the Directory, the surge in public awareness of wetlands can be maintained and that more states of South and Central America and the Caribbean will join the Ramsar Convention.

Geoffrey V.T. Matthews
Director
International Waterfowl Research Bureau

INTRODUCTION

The Neotropical Realm is the richest and most diverse of the world's eight biogeographical realms. At the same time, it is one of the least disturbed by the destructive influences of modern man. Covering the whole of the South American continent, Central America, the Caribbean and a large part of Mexico, the Neotropical Realm includes almost the full spectrum of the world's major ecosystems and a diversity of fauna and flora unmatched anywhere else. Although a considerable amount of basic faunal and floral research has been conducted and great strides have been made to protect the natural environment, the region as a whole remains relatively poorly known, and is perhaps the most vulnerable to drastic modification by man in the coming decades.

The Neotropical Realm includes a great diversity of wetland ecosystems from the coastal lagoons and mangrove swamps of the Caribbean and Central America, through the great riverine and floodplain systems of the humid tropics and the lacustrine systems of the high Andes, to the fjordland and subantarctic tundra of southern Chile and Argentina. In recent years, there has been a marked increase in awareness of the widespread threats to wetlands in the Neotropics, but to date, no serious attempt has been made to develop an overall wetland conservation strategy for the region. This document aims to provide the basis for such a strategy, by presenting a synopsis of the most important wetlands and their wildlife, and by summarizing the measures which have been taken to conserve them.

The term "wetland" is here used in the same sense as defined in the text of the Convention on Wetlands of International Importance Especially as Waterfowl Habitat (the Ramsar Convention). Thus, wetlands are "areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres". Coral reefs and other exclusively marine systems are however generally excluded from this definition, and have not been considered.

The greater part of the Directory is made up of a series of country reports grouped into the three major regions under consideration: South America, Central America (including the Neotropical portion of Mexico), and the Caribbean. Most country reports begin with an introduction which summarizes the institutional base for wetland conservation and research, the progress made to date, and the major threats to wetlands and their wildlife. Then follows an inventory of those wetlands which are known or thought to be of greatest importance from the point of view of nature conservation. The site descriptions include basic information on size and location, habitat types, principal vegetation, ownership, degree of protection, land use, fauna, threats, research, conservation and relevant literature.

In the discussion of fauna, special emphasis is given to the waterfowl for several reasons. The waterfowl of the Neotropical Realm are well known and well documented; in many other groups of aquatic fauna, our knowledge remains fragmentary, with many species still undescribed to science. Waterfowl are a popular group, conspicuous, readily identified, censused and studied; thus there tends to be much more information available on waterfowl than other wetland species. Many are long-distance migrants, dependent on wetlands in a number of countries during the course of their annual cycle, and thus demonstrating the need for international cooperation in conservation efforts. Many species are popular game birds for the hunter, and as such constitute a renewable natural resource of considerable economic value. Finally, waterfowl are particularly good indicators of the general condition of wetland ecosystems; they are at or near the top of most wetland food chains, and are highly susceptible to wetland contamination and disturbance.

The Ramsar Convention defines "waterfowl" as "birds ecologically dependent on wetlands". However, for the purposes of this Directory, the term has been restricted to wetland species of the following families: Gaviidae, Podicipedidae, Pelecanidae, Phalacrocoracidae, Anhingidae, Ciconiidae, Threskiornithidae, Phoenicopteridae, Anhimidae, Anatidae, Opisthocomidae, Gruidae, Aramidae, Rallidae, Heliornithidae, Eurypygidae, Jacanidae, Rostratulidae, Haematopodidae, Charadriidae, Scolopacidae, Recurvirostridae, Phalaropodidae, Laridae and Rynchopidae. Species of Pelecanidae, Phalacrocoracidae and Laridae which are confined to marine ecosystems, and other sea-birds (Spheniscidae, Procellariiformes, Phaethontidae, Sulidae, Fregatidae and Stercorariidae) are excluded.

Each country report includes an outline map showing the location of the sites described in the inventory. It was the original intention of the compilers to include detailed maps of each site, and indeed many of the contributors provided excellent maps of their country's wetlands. However, as the inventory grew in size, it became clear that this would not be possible for reasons of space and cost. The several hundred individual site maps which have been provided by contributors are on file at IWRB Headquarters in the U.K. and constitute an important reference source. It is to be hoped that many of these maps will be published in national wetland inventories.

The bibliography includes not only the references cited in the text, but also a number of other important publications and reports listed by the various contributors. Emphasis has been given to recent works with direct relevance to conservation issues; much of the older literature and many publications of academic rather than conservation interest have been omitted. The extensive literature on Nearctic avian migrants wintering in the Neotropics has recently been summarized by Rappole *et al* (1983); their annotated bibliography should be used in conjunction with the present bibliography.

Following the bibliography, there is a directory of contributors. This gives the names and addresses of the many individuals who have cooperated in the preparation of this work. The majority are listed according to the country for which they have provided information, but a number of individuals who have provided information for several countries or for the region as a whole are listed in a "General" section at the end.

The Directory concludes with an annotated checklist of the waterfowl of the Neotropical Realm. This gives a brief review of the distribution and abundance of all waterfowl occurring in the region, with emphasis on those species known or thought to be vulnerable or endangered and therefore in need of special attention. The checklist incorporates a large amount of new information provided by contributors, either on the waterfowl occurring at individual sites, or as status reports on waterfowl occurring in the country concerned. A number of contributors provided very detailed status reports complete with distribution maps. For reasons of space, it has not been possible to include all this material here. Along with individual site maps, the species status reports are on file at IWRB Headquarters and, subject to consent being given by the contributors, are available upon request.

Methodology

The compilation of the Directory has involved the collection of data through three main channels:

a) a series of national networks of contacts, each with a "national coordinator" who was responsible for the compilation of all data from that country, and for the preparation of a general introduction for the country report;
b) direct contact with expatriate individuals or institutions with expertize on particular sites or species in the region;
c) a review of the recent literature.

In many cases, effective national networks were established and a comprehensive national report submitted. However, in several countries it proved impossible to coordinate the collection of information through a single person or institution, and material was received from several independent sources. In a few cases, no local contact could be established, and the material summarized in the Directory is based entirely on expatriate sources and the literature. Emphasis was given throughout to obtaining first hand and up to date information from individuals currently working on wetlands and their fauna, and little attention was given to the older literature.

Site Descriptions

Contributors were requested to submit their information on wetlands on standard data sheets of a type used in similar wetland inventories in the Palearctic Realm. The information has been reproduced in this Directory in a slightly modified form, and in many cases with additional information from other sources. Each site description contains the following data categories:

Title: The name of the wetland with a reference number for the accompanying map.

Location: The geographical coordinates (Greenwich), and general location of the site. The coordinates have been taken from the Operational Navigation Charts (1:1,000,000) of the Defense Mapping Agency, Missouri, U.S.A.

Area: The area of the wetland habitat in hectares. In the case of some rivers and coastal zones, only the approximate length of the site is known.

Altitude: The altitude of the wetland in metres above sea level.

Province and type: The biogeographical province in which the wetland is situated, following Udvardy (1975) "A Classification of the Biogeographical Provinces of the World"; and a reference to the types of wetland habitat present, on the basis of the following numerical code:

01: shallow sea bays and straits
02: estuaries, deltas
03: small offshore islands, islets
04: rocky sea coasts, sea cliffs
05: sea beaches (sand, pebbles)
06: intertidal mudflats, sand flats
07: coastal brackish and saline lagoons and marshes, salt pans
08: mangrove swamps, mangrove forest
09: slow-flowing rivers, streams (lower perennial)
10: fast-flowing rivers, streams (upper perennial)
11: riverine lakes (including oxbows), riverine marshes
12: freshwater lakes and associated marshes (lacustrine)
13: freshwater ponds (under 8 ha), marshes, swamps (palustrine)
14: salt lakes, salars (inland systems)
15: reservoirs, dams
16: seasonally flooded grassland, savanna, palm savanna
17: rice paddies, flooded arable land, irrigated land
18: swamp forest, temporarily flooded forest
19: peat bogs, wet Andean meadows (bofedales), snow melt bogs

Although more sophisticated wetland classification systems are available, the information was seldom adequate to permit a more detailed breakdown, and in any case for many of the enormous wetlands described in the Directory, a detailed classification of habitat types would be extremely cumbersome.

Site description: A general description of the site.

Principal vegetation: A description of the principal aquatic vegetation, if known; in many cases, information was available only on the major terrestrial communities of the region.

Land tenure: The status of land ownership.

Protection: The extent, if any, to which the wetland habitat and its fauna are protected.

Land use: A description of the principal land use activities at the wetland and in the surrounding areas.

Waterfowl: A brief account of the importance of the site for waterfowl. The scientific nomenclature and taxonomic sequence follow Blake (1977), except in the case of some Laridae.

Other fauna: Information on other fauna dependent on the wetland habitat. In many cases, this includes bird species not normally regarded as waterfowl, such as birds of prey and some passerines. In some cases, noteworthy terrestrial species of surrounding areas are included, particularly when listed in the WWF Red Data Book. For mammals, the scientific nomenclature follows Ewer (1973) and Walker (1975).

Threats: An account of the existing and potential threats to the wetland.

Research and conservation: A review of major research activities, completed and ongoing; management plans; proposals concerning future conservation and management; and in some cases general comments on the importance of the area and need for further study.

References: Published literature and unpublished reports relevant to the site. In most cases, the literature cited has been utilized in the compilation of the data sheet.

Source: Names of individuals and institutions providing information on the site. In many cases, information from two or more sources has been combined.
Criteria for inclusion: A reference to the criterion or criteria which justify the inclusion of the site in the Directory. The criteria used in the selection process are those developed for the identification of wetlands of international importance within the context of the Ramsar Convention, and adopted by the Conference of the Parties to that Convention at Cagliari in November 1980 (Atkinson-Willes *et al*, 1982). According to these criteria, a wetland should be considered internationally important if it:

1a: regularly supports either 10,000 ducks, geese and swans (Anatidae); or 10,000 coots (*Fulica* spp); or 20,000 waders (shorebirds);
1b: regularly supports 1% of the individuals (being at least 100) in a biogeographical population of one species or subspecies of waterfowl;
1c: regularly supports 1% of the breeding pairs in a biogeographical population of one species or subspecies of waterfowl;
2a: supports an appreciable number of a rare, vulnerable or endangered species or subspecies of plant or animal;
2b: is of special value for maintaining the genetic and ecological diversity of a region because of the quality and peculiarities of its fauna and flora;
2c: is of special value as the habitat of plants and animals at a critical stage of their biological cycles;
3a: is a particularly good example of a specific type of wetland community characteristic of the climatic zone in which it lies;
3b: exemplifies an extreme stage in a hydromorphological process.

In the present inventory, the reference "123" is applied to large and important wetlands which qualify for inclusion on the basis of criteria in all three categories.

For proper application of the Ramsar criteria, it is essential that a considerable body of information be available on the site in question. For many wetlands in the Neotropical Realm, the information is so scanty that no objective evaluation of the importance of the site can be made. If all such sites were to be ignored, the Directory would become little more than an inventory of wetlands which have been well studied and well documented, and would lose its value as a basis for the identification of priorities in future wetland surveys and research. Furthermore, for application of criteria 1b and 1c, it is essential that some estimate be available for the total size of the waterfowl populations. Such estimates are available for only a handful of species in the Neotropical Realm. Thus, even when detailed censuses have been made at a site, it is seldom possible to determine if the numbers of birds present are internationally important on the basis of the Cagliari criteria. It has therefore been necessary to rely to a considerable extent on the subjective judgement of contributors in the selection of sites for inclusion in the Directory. Sites selected on this basis, *i.e.* sites which are thought to be of considerable importance but which clearly merit further investigation, are given the reference "0".

Comprehensiveness

The Directory includes entries for all forty-five countries in the Neotropical Realm. For all but two countries (Guyana and the Turks & Caicos Islands), it has been possible to provide at least a preliminary inventory of important wetlands on the basis of information received from contributors and the literature. In the case of a few countries (all of which are small Caribbean states), no local contacts were established, and the material presented herein is taken entirely from the recent literature. In one case (Costa Rica), good information was received on the wetlands, but no general introduction to wetland conservation in the country was provided.

The comprehensiveness of the individual country reports varies greatly; in general, the smaller the country, the better the knowledge of the wetlands and thus the more comprehensive the inventory. In the case of some very small countries, a single individual or institution with an intimate knowledge of that country's wetlands has been able to provide a detailed national wetland inventory including all wetlands of any significance.

In South America, most countries are large to very large, with low human population density, extensive areas which remain poorly known, and numerous wetlands, some of enormous size and many still relatively undisturbed. The wetland inventories for most of these countries are still at a very preliminary stage. Most if not all of the larger wetlands and other sites of great international importance are now known and have been included in this Directory, but there doubtless remain many smaller wetlands which will in time be found to possess special qualities which justify their designation as wetlands of international importance. At the other extreme, most Caribbean states are small to very small, with high human population density and rather few wetlands, most of which are now well known and many of which are under serious threat. The wetland inventories for most of these countries are thought to be very comprehensive; all sites of international importance have been included in this Directory, along with a number of sites which are probably of only local or national importance. The inclusion of these latter sites is at least partly justified by the rapid rate at which wetlands are disappearing throughout the Caribbean and consequent rate at which the remaining undisturbed wetlands are increasing in importance. The situation in Central America lies somewhere between these two extremes, and it is felt that for most countries in this region, the Directory gives a realistic assessment of the number of wetlands of international importance.

One of the primary objectives of the Directory is to provide the stimulus and basis for the completion of detailed national wetland inventories which should include not only more information on the sites which meet international criteria, but also details of sites of only national or even local importance. One or two such national inventories have existed for some years (e.g. in Puerto Rico), while many of the original contributions to this Directory constitute very good national inventories. Only a summary of these contributions has been incorporated here, and they will, it is hoped, be published in full in their country of origin. Most of the other contributions provide excellent skeletons upon which comprehensive national inventories can be based. Much more field work needs to be carried out, the larger wetland areas must be surveyed in detail so that key sites within them can be identified, and many new sites of national rather than international importance should be considered. Only when detailed national inventories are available for all the countries of the region will it be possible to compile the definitive directory of wetlands of international importance for the Neotropical Realm.

Derek A. Scott
Montserrat Carbonell
June 1985

COUNTRY REPORTS

South America

ARGENTINA

INTRODUCTION

by Manuel Nores

The Republic of Argentina is situated in the extreme south of the South American continent. It has a surface area of 2,776,656km^2 and a population of 30 million.

Cabrera and Willink (1973) group the various biogeographical provinces of Argentina into four domains.

The Amazonian Domain, with a predominantly hot and humid climate, dense vegetation, and a very rich and diverse fauna and flora. It includes the following provinces:
a) The Yungas, on the eastern slope of the Andes in the northwest of the country;
b) Parana, in the northeast of the country, in the Provinces of Misiones and Corrientes.

The Chaco Domain, occupying the greater part of the country; the climate is varied, but predominantly of the continental type, with light to moderate rainfall, mild winters and hot summers. The vegetation is predominantly xerophytic, with dry deciduous forest, thickets and herbaceous steppes; hydrophytic formations occur only near rivers and lakes. The Chaco Domain includes the following provinces:
a) Chaco, in the north of the country south to Cordoba, San Luis and Santa Fe Provinces;
b) Espinal, from central Corrientes and northern Entre Rios through central Santa Fe and Cordoba to San Luis, central La Pampa and southern Buenos Aires Provinces;
c) Prepuna, comprising the quebradas and dry Andean slopes of the northwest, from Jujuy to La Rioja;
d) Monte, from Salta to northeastern Chubut;
e) Pampas, comprising the eastern plains between 30°S and 39°S.

The Andean-Patagonian Domain, exposed to a rigorous climate with extremely low temperatures and low rainfall; the vegetation is highly xerophytic, with low shrubs and cushion plants. This domain includes the following provinces:
a) Altoandean, comprising the high Andes south to Tierra del Fuego;
b) Puna, comprising the altiplano from Jujuy to La Rioja;
c) Patagonia, extending from the central foothills of Mendoza south through western Neuquen, western Rio Negro, a large part of Chubut and most of Santa Cruz to northern Tierra del Fuego.

The Subantarctic Domain, with a humid temperate climate; the dominant vegetation is deciduous and evergreen forest with meadows and extensive areas of peat bog; the fauna and flora are characterized by the predominance of families and genera of austral distribution. In Argentina, this domain includes the following province:
a) Subantarctic, represented in western Neuquen, Rio Negro, Chubut, Santa Cruz and Tierra del Fuego.

Argentina possesses a wide variety of wetland systems, including rivers, lakes, lagoons, swamps, marshes, floodplains, glacial bogs, etc. This diversity of wetlands supports a very diverse aquatic avifauna; about 185 species of aquatic birds have been recorded, excluding marine species.
The wetlands of Argentina can be divided as follows:

Wetlands of the Atlantic coast, including:
a) Wetlands important for concentrations of migratory shorebirds from the northern hemisphere, e.g. Punta Rasa in Buenos Aires Province.
b) Sites of principal importance for breeding sea-birds such as *Spheniscus magellanicus*, e.g. Punta Tombo and Cabo Dos Bahias in Chubut.

Wetlands of the plains and hills, including:

a) Patagonian lakes and marshes along the base of the Andes in western Patagonia, from Neuquen to Tierra del Fuego; scenically perhaps the most beautiful part of Argentina, and the region with the most extensive system of National Parks, but generally poor in waterfowl.
b) Shallow lakes and marshes in the Patagonian steppe of Neuquen, Rio Negro, Chubut, Santa Cruz and Tierra del Fuego Provinces.
c) Shallow lakes, swamps and marshes of the Pampas, principally in the Provinces of Cordoba, Santa Fe, Buenos Aires and Santiago del Estero; these include some of the most important wetlands for waterfowl, both in terms of diversity and abundance.
d) Mesopotamian lakes, swamps and rivers in the northeast, including the great riverine systems of the Parana, Uruguay, Paraguay, Pilcomayo and Bermejo, and the lakes, marshes and tributaries under the influence of these rivers; a complex of wetlands of great importance for waterfowl.

Wetlands of the high mountains, including lakes, lagoons and wet plains, chiefly in the Andes from Jujuy to Neuquen.

Institutional Base for Wetland Conservation and Research

Buenos Aires Province
Servicio de Parques Nacionales.
Museo Argentino de Ciencias Naturales "Bernardino Rivadavia".
Centro de Investigaciones de Biologia Marina (CIBIMA).
Consejo Nacional de Investigaciones Cientificas y Tecnicas (CONICET).
Fundacion Vida Silvestre Argentina.
Asociacion Ornitologica del Plata.
Museo de La Plata.
Instituto Nacional de Investigaciones y Desarrollo Pesquero.
Natura.
Direccion Nacional de Fauna Silvestre.

Catamarca
Direccion de Agricultura y Recursos Naturales.

Chaco
Direccion de Fauna y Parques.

Chubut
Direccion de Proteccion Ambiental.
Instituto de la Patagonia.

Cordoba
Centro de Zoologia Aplicada.
Comite Cordoba de Conservacion de la Naturaleza (CONACO).
Direccion de Nautica, Caza y Pesca.

Corrientes
Centro de Zoologia Aplicada del Litoral.
Direccion de Fauna, Flora y Ecologia.

Entre Rios
Direccion de Recursos Naturales.

Formosa
Direccion de Fauna.

Jujuy
Direccion de Recursos Naturales Renovables.

La Pampa
Direccion de Recursos Naturales.

La Rioja
Direccion de Recursos Naturales Renovables.

Mendoza
Direccion de Bosques y Parques Provinciales.

Misiones
Direccion de Ganaderia.

Neuquen
Direccion General de Recursos Faunisticos.

Rio Negro
Direccion de Ganaderia.
Estacion Experimental Regional Agropecuaria San Carlos de Bariloche, Instituto Nacional de Tecnologia Agropecuaria (INTA).

Salta
Direccion de Recursos Naturales.

San Juan
Direccion de Asuntos Agropecuarios.

San Luis
Direccion de Recursos Naturales Renovables.

Santa Cruz
Direccion de Ganaderia.

Santa Fe
Direccion de Ecologia y Proteccion de la Fauna.
Instituto Nacional de Limnologia.
Centro de Proteccion de la Naturaleza.
Instituto de Defensa Ecologica "Albert Schweitzer".

Santiago del Estero
Direccion General de Bosques, Caza y Pesca.

Tucuman
Direccion de Recursos Naturales Renovables.
Instituto Miguel Lillo.

Progress in Wetland Conservation and Research

Argentina created its first National Park in 1904. At present, there are 18 National Parks, two Natural Monuments, nine National Reserves, and a number of Nature Reserves, Faunal Sanctuaries and Biosphere Reserves, in addition to many Provincial Parks, Provincial Reserves and the reserves of the Fundacion Vida Silvestre Argentina.
A number of the protected areas in Argentina incorporate wetlands; these include the following:

Monumento Nacional Laguna Pozuelos (10,000 ha), established in 1981.
Reserva Natural Formosa (10,000 ha), established in 1968.
Parque Nacional Rio Pilcomayo (50,000 ha), established in 1951; protecting part of Laguna Blanca, several smaller lakes including Laguna Trampa and Laguna Llanten, the Baracalde and Yaguarete Marshes, and a section of the Rio Pilcomayo.

Parque Nacional El Chaco (15,000 ha), established in 1954; protecting Laguna de Panza de Cabra and various swampy areas.

Parque Nacional Iguazu and Reserva Nacional Iguazu (55,500 ha), partly protected since 1909, and given its present status in 1979; the protected area includes a section of the Rio Iguazu and various small tributaries.

Parque Nacional Laguna Blanca and Reserva Nacional Laguna Blanca (11,250 ha), established in 1940; protecting Laguna Blanca (1,700 ha).

Parque Nacional Lanin and Reserva Nacional Lanin (379,000 ha), established in 1937; protecting a number of lakes including Huechulafquen, Tromen and Lolog.

Parque Nacional Nahuel Huapi and Reserva Nacional Nahuel Huapi (758,100 ha); some protection has been afforded to the area since 1904, and the park was established in 1934. The Park and Reserve protect various lakes including Nahuel Huapi, Traful and Espejo, along with numerous rivers and streams.

Parque Nacional Lago Puelo (23,700 ha), established in 1971; Lago Puelo has been afforded some protection since 1937.

Parque Nacional los Alerces and Reserva Nacional los Alerces (263,000 ha), established in 1937; protecting various lakes including Futalaufquen, Menendez and Rivadavia.

Parque Nacional Perito Francisco P. Moreno and Reserva Nacional Perito Francisco P. Moreno (115,000 ha), established in 1937; protecting various lakes including Belgrano, Burmeister and Nansen.

Parque Nacional Los Glaciares and Reserva Nacional Los Glaciares (600,000 ha), established in 1937; protecting Lago Argentina and Lago Viedma.

Parque Nacional Tierra del Fuego (63,000 ha), established in 1960; protecting Lago Fagnano and a small part of Lago Roca.

A list of Provincial Reserves prepared by the Fundacion Vida Silvestre Argentina includes the following reserves which contain significant wetland areas:

Laguna Salada Grande, Isla Botija, Isla Martin Garcia, Isla Laguna Alsina and Samborombon, in Buenos Aires Province.
Laguna Blanca, in Catamarca.
Isla del Cerrito, in Chaco.
Golfo San Jose, Punta Tombo, Cabo Dos Bahias, Isla los Pajaros, Punta Norte, Punta Delgada and Punta Piramides, in Chubut.
Mar Chiquita, in Cordoba.
Pilaga and Laguna Hu, in Formosa.
Yala, in Jujuy.
Laguna Brava, in La Rioja.
Los Alamos and Laguna Llancanelo, in Mendoza.
Islas Malvinas and Isla Itacua, in Misiones.
San Guillermo, in San Juan.
Cabo Blanco and Estuario del Rio Deseado, in Santa Cruz.
Laguna La Loca, Campo Rico and Vira-Pita, in Santa Fe.

The Fundacion Vida Silvestre Argentina has also established two reserves which include wetlands: Campos del Tuyu in Buenos Aires Province and Los Escarchados in Santa Cruz.

While there are various organizations and research institutions in Argentina which include waterfowl in their research programmes, there are no programmes devoted specifically to the study of wetlands and waterfowl. Some of the research projects which involve or have involved wetlands and waterfowl include the following:

a) A bird banding programme in Argentina, carried out by the Instituto Miguel Lillo in Tucuman under the direction of Claes Olrog, from 1960 to the present time. Most of the banding has been carried out in the Bañados de Figueroa, but there have also been banding projects in Patagonia, on the Atlantic coast, and at wetlands in the centre of the country. The Comision Avutarda, led by Mauricio Rumboll, was developed as a part of this programme for the study and banding of species of the genus *Chloephaga*; some 5,000 individuals have now been banded and marked with neck-collars.
b) A project on the freshwater fauna of Argentina, conducted by the Consejo Nacional de Investigaciones Cientificas y Tecnicas, under the direction of Raul Ringuelet. Work

conducted on Anseriformes by Jorge Navas has already been published.

c) A study of the waterfowl and wetlands of Cordoba Province, carried out under the direction of Manuel Nores of the Subsecretaria de Estado de Agricultura y Ganaderia in Cordoba. The work was conducted between 1973 and 1980, and the results have been published in Nores and Yzurieta (1980).
d) A survey of the continental wetlands of Argentina, carried out by the Instituto Nacional de Investigaciones y Desarrollo Pesquero (Quiros *et al*, 1983).

Major Threats to Wetlands and Waterfowl

In general, wetlands are the least modified of the natural environments in Argentina, and there still exist large numbers of water bodies of various types both in the lowlands and in the Andes.

Of the various threats which have been recognized, the most serious are those arising from the construction of dikes which, by diverting water supplies, have in many cases resulted in the drying out of swamps and marshes, e.g. at the Bañados de Figueroa in Santiago del Estero, and at the Bañados de la Amarga in Cordoba. In other cases, the construction of dikes has affected the equilibrium of the aquatic systems, resulting in the drying out of wetlands in periods of low rainfall and extensive flooding during periods of heavy rainfall. The most notable example of this has been at Laguna Mar Chiquita and the Bañados del Rio Dulce, in Cordoba.

On the other hand, dikes can also favour waterfowl, since they create new water bodies, sometimes with characteristics similar to those of natural wetlands. This has been the case at Dique Cruz del Eje in Cordoba, at Dique de la Cienaga in Tafi del Valle, Tucuman, and at Lago Pellegrini in Rio Negro.

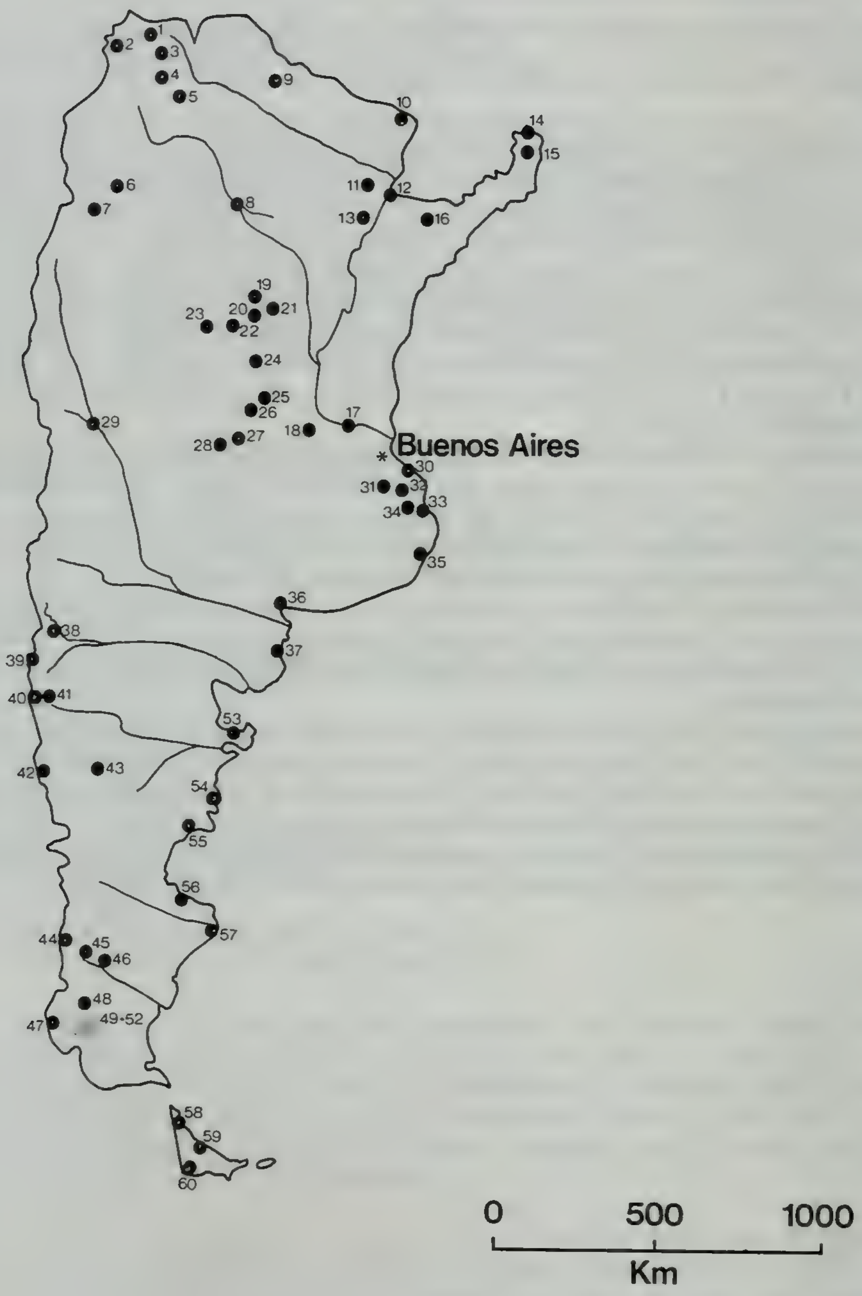
The Esteros del Ibera, one of the most important wetlands in the country, are threatened by a project to prevent flooding from the Rio Parana. Excess water in the Parana would be channelled by means of a canal to the Esteros, creating a single large body of open water, and eliminating the majority of wetland habitats in the Esteros. At the same time, there exists a project for the establishment of a National Park in this region.

The diversion of small rivers and streams for irrigation and other purposes has had a similar effect to that of the dikes, with wetlands drying out as a result of a reduction in their water supply. This has been the case at the Bañados del Soto and other wetlands in the highlands of Cordoba Province.

Another problem at some wetlands is the disturbance caused by boat traffic. There are some lakes which now hold very few waterfowl because of intensive use by motor boats for fishing and other sporting activities. The problem is often aggravated by the elimination of aquatic plants with herbicides to facilitate the movement of boats.

While in some other countries, pollution and drainage pose serious threats to wetlands, in Argentina they are of only minimal importance, at least for the moment.

ARGENTINA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WETLANDS

The site descriptions are based on data sheets prepared by Manuel Nores of the Centro de Zoologia Aplicada de Cordoba, and Sergio A. Salvador, with contributions from Dario Yzurieta, Samuel Narosky, Pablo Canevari, Claes Olrog, Rosendo M. Fraga, Rodolfo Miatello, Roberto Straneck, J. Rodriguez Mata and Juan F. Klimaitis. Data sheets were also provided by Jon Fjeldsa, Mauricio Rumboll, Mariano A. Gelain, Laura S. Rozenberg and Ricardo Banchs, and additional information was received from Hugo Castello, Claudio E. Chehebar, the Fundacion Vida Silvestre Argentina (Juan C. Chebez and Andrew Johnson), Brian A. Harrington and J. Peterson Myers.

Using satellite imagery and maps of the Military Geographical Institute, Manuel Nores has prepared a list of 254 wetlands additional to those described below. These include lakes, lagoons, swamps and dams, and are distributed as follows: Jujuy 21; Salta 16; Tucuman 3; Catamarca 25; Santiago del Estero 3; Formosa 11; Chaco 15; Corrientes 5; Entre Rios 5; Santa Fe 10; Cordoba 6; La Rioja 6; San Juan 4; Mendoza 18; San Luis 2; Buenos Aires 15; La Pampa 10; Neuquen 15; Rio Negro 11; Chubut 27; Santa Cruz 20 and Tierra del Fuego 6. No further information is available on these wetlands at the present time.

Laguna Pozuelos (1)

Location: 22°20'S, 66°00'W; 50 km southwest of La Quiaca, Jujuy Province.
Area: 10,000 ha.
Altitude: 3,500m.
Province and type: 8.36.12; 14 & 19.
Site description: A large permanent oligosaline Andean lake with little aquatic vegetation; and nearby fresh to slightly saline marshes and bogs. The water level in the lake is much reduced during the dry season, exposing extensive mudflats.
Principal vegetation: Aquatic vegetation is principally *Myriophyllum* sp. The lake is in the puna zone, with semi-arid steppe of *Festuca, Stipa, Fabiana* and *Baccharis* spp.
Land tenure: State owned.
Protection: Protected within the Laguna Pozuelos National Monument (28,000 ha) established in 1981.
Land use: Formerly intensive grazing by domestic animals, but this is reportedly being stopped. The area was however still being heavily grazed in January 1984. There is some mining in the area.
Waterfowl: Probably the most important wetland for waterfowl in the northern Andes of Argentina, with large numbers of breeding birds and migrants from elsewhere in the Andes and from the Nearctic Region. All three Andean species of flamingos occur in large numbers with up to 26,000 birds present at one time. *Phoenicopterus chilensis* appears to be the most numerous species, and this is known to breed (e.g. in autumn 1983), but both *Phoenicoparrus andinus* and *P. jamesi* occur regularly in hundreds if not thousands. The lake is particularly important as a regular haunt of *Fulica cornuta*, which is fairly common and known to breed in the area. Pozuelos is also one of the few localities in Argentina for *Fulica gigantea*. Some of the commoner Andean waterfowl occur in very large numbers; e.g. in February 1982, at the south end of the lake there were 300 *Podiceps occipitalis*, 2,000 *Chloephaga melanoptera*, 2,000 *Lophonetta specularioides*, 1,000 *Anas georgica* and 500 *A. flavirostris*. The rather scarce and local *Recurvirostra andina* is common (over 100 in February 1982), as are *Himantopus himantopus, Vanellus resplendens* and *Charadrius alticola*. Several species of Nearctic shorebirds occur in large numbers in the austral summer; recent incomplete counts have included 300 *Tringa flavipes*, 1,000 *Calidris bairdii*, over 1,000 *C. melanotos*, over 10,000 *Steganopus tricolor*, and smaller numbers of *Tringa melanoleuca, Limosa haemastica*, and *Micropalama himantopus*.
Other fauna: The Puna Rhea *Pterocnemia pennata tarapacensis* and the Vicuna *Vicugna vicugna* occur on the surrounding puna.
Threats: Heavy grazing by domestic animals is still causing problems in the reserve, and severe soil erosion resulting from overgrazing in the past has increased siltation rates.

Research and conservation: The National Monument is still being developed, with the long-term objective being a major park surrounded by a multiple use area for the farming activities of the Colla Indians.
References: Contino (1965); Hurlbert (1978); Erize *et al* (1981); IUCN (1982); Canevari (undated).
Source: Jon Fjeldsa, Manuel Nores, Pablo Canevari and Derek A. Scott.
Criteria for inclusion: 123.

Laguna Vilama (2)

Location: 22°35'S, 66°55'W; 120 km west of Abra Pampa, Jujuy Province.
Area: 8,000 ha.
Altitude: 4,400m.
Province and type: 8.36.12; 14.
Site description: A large permanent oligosaline Andean lake, subject to wide fluctuations in water level and freezing in winter.
Principal vegetation: Large beds of *Myriophyllum.*
Land tenure: State owned.
Protection: None.
Land use: None known.
Waterfowl: Similar to Laguna Pozuelos. Up to 1,500 *Phoenicoparrus jamesi* have been recorded, and the species has nested. *P. andinus* has also been reported but in much smaller numbers. The area is important for *Fulica* spp.
Other fauna: No information.
Threats: None known.
Research and conservation: A proposal has been made for the establishment of a reserve.
References: Hurlbert (1978); Hurlbert & Keith (1979).
Source: Manuel Nores and Roberto Straneck.
Criteria for inclusion: 1b.

Laguna Runtuyoc (3)

Location: 22°39'S, 65°41'W; near Abra Pampa, Jujuy Province.
Area: 600 ha.
Altitude: 3,400m.
Province and type: 8.36.12; 12.
Site description: A permanent shallow freshwater Andean lake and marshes, subject to wide fluctuations in water level, and freezing in winter.
Principal vegetation: Beds of *Scirpus* and *Myriophyllum* spp.
Land tenure: Privately owned.
Protection: None.
Land use: A little cattle ranching.
Waterfowl: A variety of Andean waterfowl in small numbers, including *Pelgadis ridgwayi, Phoenicopterus chilensis, Anas puna* and *A. platalea.*
Other fauna: No information.
Threats: Some collection of eggs by local inhabitants.
Research and conservation: A proposal has been made for the establishment of a reserve.
Source: Manuel Nores and Claes Olrog.
Criteria for inclusion: 3a.

Laguna Guayatayoc (4)

Location: 23°10'S, 65°33'W; 60 km south of Abra Pampa, Jujuy Province.
Area: 100,000 ha salar with small areas of open water.

Altitude: 3,660m.
Province and type: 8.36.12; 14.
Site description: A vast salar (salt basin) with fringing oligosaline to hypersaline lakes.
Principal vegetation: No information.
Land tenure: No information.
Protection: None.
Land use: No information.
Waterfowl: An important area for flamingos; up to 4,000 have been observed including over 2,000 *Phoenicoparrus jamesi* and smaller numbers of *P. andinus* and *Phoenicopterus chilensis.*
Other fauna: No information.
Threats: No information.
References: Hurlbert (1978).
Source: See references.
Criteria for inclusion: 1b.

Laguna Volcan and the Yala Lakes (5)

Location: Laguna Volcan 23°56'S, 65°28'W; Yala Lakes 24°07'S, 65°28'W; 25-35 km northwest of Jujuy, Jujuy Province.
Area: Laguna Volcan 50 ha; Yala Lakes c.100 ha.
Altitude: 1,600-2,100m.
Province and type: 8.37.12; 10 & 12.
Site description: Four small permanent freshwater mountain lakes and the nearby Rio Yala, a fast-flowing mountain river. Laguna Volcan has abundant aquatic vegetation.
Principal vegetation: Beds of *Scirpus* and *Typha.*
Land tenure: Laguna Volcan is privately owned.
Protection: The Yala Lakes are within a Provincial Reserve; Laguna Volcan is unprotected.
Land use: Recreation, particularly sport fishing.
Waterfowl: A variety of breeding waterfowl, including *Oxyura jamaicensis ferruginea, Gallinula chloropus garmani* and three species of coot, *Fulica americana, F. armillata* and *F. rufifrons. Merganetta armata* and the very local Rufous-throated Dipper *Cinclus schultzi* are fairly common along the Rio Yala.
Other fauna: No information.
Threats: None known.
Research and conservation: A proposal has been made for the establishment of a reserve at Laguna Volcan.
Source: Manuel Nores and Derek A. Scott.
Criteria for inclusion: 2a & 3a.

Wetlands in Laguna Blanca Provincial Nature Reserve (6)

Location: 26°30'-27°00'S, 66°30'-67°30'W; in the Department of Belen, Catamarca Province.
Area: 1,100 ha of wetlands.
Altitude: 3,800m.
Province and type: 8.37.12; 10, 14 & 19.
Site description: A shallow saline Andean lake (Laguna Blanca), fast-flowing mountain rivers and streams, and Andean bogs fed by snow melt.
Principal vegetation: In the high Andean puna zone, with very open low shrub communities and grassland.
Land tenure: A small part is state owned; the remainder is private.
Protection: Included within the Laguna Blanca Provincial Nature Reserve (770,000 ha) established in 1979 and designated as a Biosphere Reserve in 1982.
Land use: Grazing of domestic livestock including cattle, sheep, llamas and donkeys.
Waterfowl: An important area for species of Anatidae and flamingos.
Other fauna: There is a good population of Vicuna *Vicugna vicugna* in the reserve, and the Puna Rhea *Pterocnemia pennata tarapacensis* occurs.

Threats: Overgrazing by domestic livestock causes problems in the reserve.
References: IUCN (1982).
Source: See references.
Criteria for inclusion: 3a.

Laguna Los Nacimientos (7)

Location: 27°27'S, 67°38'W; 15 km north of Fiambala, Catamarca Province.
Area: 60 ha.
Altitude: 1,700m.
Province and type: 8.37.12; 12 & 16.
Site description: A permanent freshwater lake, several metres deep, at medium elevation in the Andes, with abundant aquatic vegetation and surrounding wet meadows.
Principal vegetation: Beds of *Typha* sp.
Land tenure: Privately owned.
Protection: None.
Land use: Negligible.
Waterfowl: A wide variety of waterfowl occur, including both highland and lowland species.
Other fauna: No information.
Threats: None known.
Source: Manuel Nores and Rodolfo Miatello.
Criteria for inclusion: 3a.

Bañados de Figueroa (8)

Location: 27°25'S, 63°40'W; 75 km ENE of Santiago del Estero, Santiago del Estero Province.
Area: 60,000 ha.
Altitude: 160m.
Province and type: 8.25.7; 13 & 16.
Site description: A large area of shallow freshwater ponds and marshes, small seasonal lakes, seasonally flooded grassland and saline flats along the Rio Salado. Flooding occurs in January and February, and the water level then declines gradually through the dry season. The wetland area was greatly reduced in extent following the construction of the Figueroa Dam, but this was destroyed in the floods of 1982, and the entire area of marshes became reflooded.
Principal vegetation: Marshes with species of *Scirpus* and halophytic Chenopodiaceae; in a region of dry chaco woodland.
Land tenure: Partly private and partly state owned.
Protection: None.
Land use: Cattle ranching and hunting on a small scale.
Waterfowl: Very important for a wide variety of waterfowl, both as a breeding area for resident species, and as a wintering area for waterfowl breeding in the pampas and Patagonia. Recent counts have included 500-600 *Rollandia rolland*, 3,000-5,000 *Phalacrocorax olivaceus*, 1,000-1,500 *Egretta thula*, 2,000-3,000 *Plegadis chihi*, 1,000-1,500 *Phoenicopterus chilensis*, 1,500-2,000 *Dendrocygna bicolor*, 800-1,000 *Anas leucophrys*, 500-600 *Netta peposaca*, 200-300 *Porphyriops melanops*, 25,000-30,000 *Fulica leucoptera* and 400-500 *Himantopus himantopus*. Seven species of Nearctic shorebird have been recorded in small numbers.
Other fauna: The Coypu *Myocastor coypus* occurs.
Threats: There is a project to rebuild the Figueroa Dam, destroyed by floods in February 1982. If this is completed, a large part of the marshes will again be destroyed.
Research and conservation: A management plan has been drawn up to alleviate ecological damage should the Figueroa Dam be rebuilt. A number of bird surveys and banding programmes have been conducted in the area.
References: Olrog (1953 & 1965).
Source: Manuel Nores, Dario Yzurieta and Sergio A. Salvador.
Criteria for inclusion: 123.

Wetlands in Formosa Nature Reserve (9)

Location: 24°10'S, 62°00'W; in western Formosa Province, on the border with Chaco Province.
Area: Several thousand ha.
Altitude: 50-70m.
Province and type: 8.21.4; 09, 11 & 16.
Site description: Slow-flowing rivers and streams, riverine marshes, seasonal lakes and marshes, and extensive areas of seasonally flooded grassland and woodland between the Teuco and Teuquito rivers; part of a much larger area of chaco subject to seasonal inundation.
Principal vegetation: In the dry chaco, with xerophytic woodlands dominated by *Schinopsis quebrachocolorado, Aspidosperma quebrachoblanco* and *Prosopis* spp.
Land tenure: State owned.
Protection: Within the Formosa Nature Reserve (10,000 ha) established in 1968.
Land use: Some wood-cutting, grazing of domestic livestock and burning by local settlers.
Waterfowl: A wide variety of chaco/pantanal species including *Jabiru mycteria, Harpiprion caerulescens* and *Cairina moschata.*
Other fauna: The Maned Wolf *Chrysocyon brachyurus* occurs in the Reserve.
Threats: Overgrazing, wood-cutting, burning and illegal hunting. A dam has been constructed within the Reserve.
Research and conservation: Basic floral and faunal investigations have been carried out.
References: IUCN (1982).
Source: See references.
Criteria for inclusion: 3a.

Rio Pilcomayo and Laguna Blanca (10)

Location: 25°00'-25°15'S, 57°55'-58°10'W; near the confluence of the Pilcomayo and Paraguay Rivers, Formosa Province.
Area: 60,000 ha.
Altitude: 60m.
Province and type: 8.21.4; 09, 11, 12, 13 & 16.
Site description: A vast complex of slow-flowing rivers and streams, riverine marshes, permanent and seasonal freshwater lakes and marshes, swamps, and seasonally flooded grassland, palm savanna and forest along the Rio Pilcomayo.
Principal vegetation: In the transition zone between the eastern chaco and the humid subtropical forests of southeastern Paraguay, with gallery forest along the water courses, palm savannas dominated by *Copernicia australis* and chaco woodland in the drier areas. The aquatic vegetation includes *Eichhornia, Pistia* and *Typha* spp.
Land tenure: State owned.
Protection: Partly included within the Rio Pilcomayo National Park (50,000 ha) established in 1951.
Land use: Cattle ranching. The Park has not been developed and there are few visitors, although the numbers are increasing.
Waterfowl: The rich and diverse bird fauna is typical of the eastern chaco/pantanal wetlands, and includes all three storks Ciconiidae, five common species of Threskiornithidae, *Chauna torquata*, all three *Dendrocygna* spp, *Sarkidiornis melanotos* and *Cairina moschata.*
Other fauna: A rich mammalian fauna includes the Maned Wolf *Chrysocyon brachyurus*, La Plata Otter *Lutra platensis*, Coypu *Myocastor coypus* and Crab-eating Fox *Cerdocyon thous.* The Swamp Deer *Blastocerus dichotomus* has apparently been exterminated by poachers. Both *Caiman crocodilus* and *C. latirostris* occur.
Threats: Part of the Laguna Blanca area has recently been excluded from the Park, and there is still a considerable amount of illegal grazing, burning and hunting in the Park.
Research and conservation: Better enforcement of the Park regulations is called for, and the whole of Laguna Blanca should be reincorporated in the Park.
References: Erize *et al* (1981); IUCN (1982); Canevari (undated).
Source: Manuel Nores and Pablo Canevari.
Criteria for inclusion: 123.

Wetlands in Chaco National Park (11)

Location: 26°50'S, 59°40'W; 90 km northwest of Resistencia, Chaco Province.
Area: Several thousand ha of wetlands.
Altitude: 70m.
Province and type: 8.21.4; 09, 11, 12, 13 & 16.
Site description: Slow-flowing rivers, riverine marshes, shallow freshwater lakes, swamps and seasonal marshes, and extensive areas of seasonally flooded grassland and palm savanna. Laguna Panza de Cabra in the southeast of the Park is a large permanent lake with rich aquatic vegetation. Most of the other lakes and marshes dry out in the dry season.
Principal vegetation: In the humid eastern chaco zone with palm savannas dominated by *Copernicia australis* and quebracho woodland with *Schinopsis balansae.*
Land tenure: State owned.
Protection: Within the Chaco National Park (15,000 ha), first established in 1934 and upgraded in 1954.
Land use: Some grazing of livestock and susbsistence cultivation by settlers in the Park.
Waterfowl: A rich and diverse chaco/pantanal fauna, with good numbers of most waterfowl typical of the region; particularly important during the rainy season. Some of the commoner species include *Ardea cocoi, Syrigma sibilatrix, Jabiru mycteria, Mycteria americana, Euxenura maguari, Plegadis chihi, Chauna torquata, Anas leucophrys, Amazonetta brasiliensis* and *Aramides ypecaha.*
Other fauna: The Maned Wolf *Chrysocyon brachyurus* has been recorded.
Threats: Settlers in the Park have caused some ecological disturbance, and there have been problems with illegal wood-cutting and poaching, but the Park has recently been fenced and the problems now seem to be under control.
References: Erize *et al* (1981); IUCN (1982).
Source: Derek A. Scott.
Criteria for inclusion: 3a.

Isla del Cerrito (12)

Location: 27°21'S, 58°41'W; at the confluence of the Parana and Paraguay Rivers, north of Corrientes, Chaco Province.
Area: 400 ha.
Altitude: 60m.
Province and type: 8.21.4; 09, 11 & 18.
Site description: A low-lying island with a very diverse range of habitats including riverine marshes, oxbow lakes, gallery forest and humid chaco woodland, at the confluence of two great rivers. Large areas of marsh and forest are flooded during the rainy season.
Principal vegetation: No information.
Land tenure: No information.
Protection: The island was declared a Provincial Reserve in the 1970s.
Land use: An important area for sport fishing; there is some cattle grazing and cultivation on a small scale.
Waterfowl: A good selection of chaco/pantanal species.
Other fauna: Mammals include the rare Swamp Deer *Blastocerus dichotomus*, Maned Wolf *Chrysocyon brachyurus* and Capybara *Hydrochoerus hydrochaeris.* The principal sport fish is *Salminus maxillosus.*
Threats: Considerable ecological damage has occurred as a result of forest clearance, shifting agriculture and overgrazing. There is a considerable amount of illegal hunting, and this is likely to increase with the contruction of roads on the island.
Research and conservation: A proposal has been made for the establishment of a biological research station on the island. An improvement in the integrity of the reserve is called for on both biological and touristic grounds.
References: Hancock & Perrins (1983).
Source: See references.
Criteria for inclusion: 2a, 2b & 3a.

Bajos Submeridionales (13)

Location: 27°30'-29°30'S, 59°15'-61°00'W; southeast of Resistencia, in the Provinces of Chaco and Santa Fe.
Area: c.1,000,000 ha.
Altitude: 50-60m.
Province and type: 8.21.4; 9, 11, 12, 13, 16 & 18.
Site description: A vast area of slow-flowing rivers, riverine marshes, oxbow lakes, permanent and seasonal freshwater lakes and marshes, swamp forest, and seasonally inundated grassland, palm savanna and riverine forest. Two of the larger permanent lakes are Laguna del Toro and Laguna La Loca. Most of the wetlands are shallow, not exceeding 1.5m in depth.
Principal vegetation: Marshes with species of *Scirpus, Typha* and *Myriophyllum.* In a region of humid eastern chaco woodland and palm savanna.
Land tenure: A mixture of private and state ownership.
Protection: There are some small Provincial Reserves, e.g. the Laguna La Loca Provincial Reserve, but most of the area is unprotected.
Land use: Cattle ranching, with some agriculture, hunting and fishing.
Waterfowl: One of the most important waterfowl areas in northern Argentina, with large concentrations of breeding birds and winter visitors from the pampas. Particularly important for Ardeidae (seven abundant species), Ciconiidae, *Plegadis chihi, Chauna torquata*, Anatidae and Rallidae. Recent censuses have revealed 80-100 *Syrigma sibilatrix*, 400-600 *Egretta alba*, 200-250 *Ardea cocoi*, 800-1,000 *Mycteria americana*, 250-300 *Euxenura maguari*, 800-1,000 *Plegadis chihi*, 300-400 *Ajaia ajaja*, 1,000-1,500 *Chauna torquata*, 80-100 *Anas leucophrys*, 80-100 *Oxyura dominica*, 80-100 *Aramus guarauna*, 80-100 *Porphyrula martinica* and 300-400 *Jacana jacana.* The area is also very important for Nearctic shorebirds, particularly *Tringa melanoleuca, T. flavipes, T. solitaria* and *Calidris melanotos.*
Other fauna: No information.
Threats: None at present, but a proposal has been made to drain parts of the area.
Source: Manuel Nores, Dario Yzurieta, Sergio A. Salvador, Samuel Narosky, Rosendo Fraga and J. Peterson Myers.
Criteria for inclusion: 123.

Rio Iguazu and tributaries (14)

Location: 25°40'S, 54°25'W; near Puerto Iguazu, Misiones Province.
Area: Several thousand ha of wetlands.
Altitude: 100-300m.
Province and type: 8.8.2; 10 (also some 12 & 15).
Site description: Fast-flowing rivers and streams, with rapids and waterfalls, in humid subtropical forest, and some small freshwater ponds, dams and marshes. Water levels rise considerably during the rainy season. "Tunnel" streams flowing north through heavy forest into the Rio Iguazu are mostly clear with a fairly regular flow. However, streams with headwaters outside the National Park become very turbid after rains because of erosion of the lateritic soils. The Rio Iguazu itself has changed radically in the last twenty years, as a result of extensive forest clearance and subsequent soil erosion in its watershed. A hydroelectric dam has been built at Dique Ossorio, 300 km up river in Brazil, and this influences the flow in the river; the hydroelectric turbines are shut down at the weekends and this results in a drop in water level at Iguazu on Mondays and a rise again at midday on Tuesdays. Road-building in the National Park has altered drainage patterns and created several small ponds and marshes near Iguazu Falls.
Principal vegetation: In a region of humid subtropical forest.
Land tenure: State owned.
Protection: Partly within the Iguazu National Park (49,200 ha) first initiated in 1909 and brought up to its present status in 1972; partly within the Iguazu National Reserve (6,300 ha) established in 1979; and partly unprotected.

Land use: Tourism in the National Park.
Waterfowl: A wide variety of waterfowl occur in small numbers. Species typical of the riverine habitats and forested streams include *Anhinga anhinga, Mesembrinibis cayennensis, Cairina moschata* and *Heliornis fulica.* The endangered Brazilian Merganser *Mergus octosetaceus* still occurs in very small numbers, and the even rarer nominate race of the Fasciated Tiger-Heron *Tigrisoma fasciatum fasciatum* may occur.
Other fauna: The two rare otters *Lutra platensis* and *Pteronura brasiliensis*and the Brazilian Spectacled Caiman *Caiman latirostris* occur in the Park. Amphibians include *Bufo marinus paraenemis*, and the fishes include *Pimelodus maculatus* and *P. clarias.*
Threats: The principal threat is the increasing turbidity of the Rio Iguazu and tributaries arising outside the Park as a result of watershed degradation. There is some illegal hunting and cutting of palms *Euterpe edulis.*
Research and conservation: Detailed studies of the avifauna have been carried out by various workers.
References: IUCN (1982); Parques Nacionales (1983).
Source: Manuel Nores and Mauricio Rumboll.
Criteria for inclusion: 2a, 2b & 3a.

Rio Uruguai (15)

Location: 25°55'S, 53°50'-54°35'W; 60 km northeast of El Dorado, Misiones Province.
Area: c.100 km of river.
Altitude: 200m.
Province and type: 8.8.2; 10.
Site description: A small fast-flowing river and tributary streams draining a relatively undisturbed area of humid subtropical forest; clear-running, with many rapids and deep pools. The least spoiled of the rivers in Misiones.
Principal vegetation: In a region of humid subtropical forest.
Land tenure: Owned by the Local Government.
Protection: None.
Land use: None at present, except for some hunting.
Waterfowl: Because of its undisturbed nature, the river has good populations of several species which are rare elsewhere in Misiones. The endangered Brazilian Merganser *Mergus octosetaceus* was found to be fairly common in the 1950s; five birds were observed by Andrew Johnson of FVSA in June 1984, and the species is still believed to breed in the area.
Other fauna: The La Plata Otter *Lutra platensis* occurs. The rare parrot *Amazona pretrei* has recently been recorded (the only known site in Argentina).
Threats: Plans exist to dam the river for hydroelectricity, apparently more for political than economic reasons. The resultant lake would flood 80 km of the valley.
Research and conservation: A survey of 100 km of river by canoe in December 1983 amply demonstrated the significance of the Rio Uruguai as one of the last unspoiled rivers in the subtropical forests of northeastern Argentina. Every effort should be made to ensure that this area is protected in its pristine state, rather than destroyed with the construction of a dam of dubious economic viability.
References: Partridge (1954).
Source: Mauricio Rumboll.
Criteria for inclusion: 2a, 2b & 3a.

Esteros del Ibera (16)

Location: 27°30'-29°00'S, 56°30'-59°00'W; between the Parana and Uruguay Rivers, central Corrientes Province.
Area: 1,100,000 ha.
Altitude: 60m.
Province and type: 8.32.11; 09, 11, 12, 13 & 16.

Site description: A vast complex of permanent shallow freshwater lakes up to 5m deep; swamps with slow-moving water and extensive floating vegetation; slow-flowing rivers and streams with riverine forest; seasonal marshes; and seasonally inundated grassland. The principal lakes are Laguna Tigre, L. de Luna, L. Galarza, L. Parana, L. Ibera and L. Fernandez.
Principal vegetation: In a region of gently undulating grassland with scattered *Prosopis algarrobilla* and *Acacia caven*; managed for cattle ranching. The lakes and swamps have extensive areas of *Eichhornia* sp and a rich growth of submergent vegetation. The dominant vegetation in the marshes includes *Scirpus*, *Typha* and *Phragmites* spp.
Land tenure: Mainly privately owned, in large estancias of 20,000-60,000 ha and many small holdings; some areas are state owned (fiscal).
Protection: None at present.
Land use: Cattle ranching, hunting and fishing; there is a big hunting industry for fur-bearing mammals.
Waterfowl: A very important area for chaco/pantanal waterfowl, with large breeding populations of Ardeidae, Ciconiidae, Threskiornithidae, and Rallidae. *Chauna torquata* and the tree ducks *Dendrocygna* spp are common, and *Jacana jacana* is abundant.
Other fauna: Despite heavy hunting pressure, there are still significant populations of the Swamp Deer *Blastocerus dichotomus* (the most important population left in Argentina), *Lutra platensis*, *Hydrochoerus hydrochaeris*, and *Myocastor coypus*. *Caiman crocodilus* and *C. latirostris* are both common.
Threats: Excessive hunting has already exterminated the big cats, and is now threatening the deer and otter populations. A variety of drainage schemes have been proposed, notably a proposal in 1972 to drain over one million ha for ranching and agriculture. This scheme was abandoned because of the fragile soils which are highly suceptible to overgrazing and drought. There have also been proposals to build dams for hydroelectricity and irrigation along the Parana River, and there is currently a proposal to divert the waters of the Parana to reduce the extent of flooding in the rainy season.
Research and conservation: The area has great potential for nature-oriented tourism on some of the larger estancias, and this has already started to be developed. There has been a proposal for the creation of a National Park of upto 500,000 ha since 1939, but no action has been taken to date.
References: Erize *et al* (1981); Hancock & Perrins (1983).
Source: Manuel Nores and Dario Yzurieta.
Criteria for inclusion: 123.

Marshes of the lower Rio Parana (17)

Location: 31°40'S, 60°40'W to 34°20'S, 58°30'W; between Parana town and the Rio de la Plata, Entre Rios and Buenos Aires Provinces.
Area: c.1,500,000 ha of wetlands along 370 km of river.
Altitude: 0-30m.
Province and type: 8.31.11; 09, 11 & 16.
Site description: The vast riverine marshes and flood plain of the lower Rio Parana, with numerous permanent and seasonal freshwater lakes and marshes, slow-flowing river channels, low-lying islands, and extensive areas of seasonally flooded grassland.
Principal vegetation: Marshes with species of *Scirpus*, *Eichhornia* and *Typha*.
Land tenure: A mixture of state and private ownership.
Protection: Very largely unprotected; there are several small Provincial Reserves in Buenos Aires Province in the south (Isla Botija, Isla Martin Garcia and Isla Laguna Alsina).
Land use: Forestry and tourism.
Waterfowl: An extremely important area for waterfowl notably Ardeidae, Ciconiidae, Threskiornithidae, Rallidae and shorebirds. *Plegadis chihi* and *Chauna torquata* are particularly abundant. Rallidae include *Aramides* spp, *Laterallus melanophaius* and *L. leucopyrrhus*, and the most abundant shorebirds are *Tringa melanoleuca*, *T. flavipes* and *Calidris melanotos*.
Other fauna: The area is one of the last strongholds of the rare La Plata Otter *Lutra platensis*, and the Swamp Deer *Blastocerus dichotomus* still occurs.
Threats: No information.
References: WWF Red Data Book.

Source: Manuel Nores and Derek A. Scott.
Criteria for inclusion: 123.

Laguna Melincue and nearby lakes (18)

Location: 33°42'S, 61°28'W; 110 km southwest of Rosario, Santa Fe Province.
Area: 12,000 ha.
Altitude: 90m.
Province and type: 8.31.11; 12 & 14.
Site description: A large permanent shallow oligosaline and sulphurous lake with little aquatic vegetation (Laguna Melincue), and several small freshwater lakes and marshes nearby. Laguna Melincue is currently increasing in size.
Principal vegetation: The freshwater lakes support a rich growth of aquatic vegetation dominated by *Scirpus* sp.
Land tenure: A mixture of private and state (fiscal) ownership.
Protection: None.
Land use: None.
Waterfowl: Laguna Melincue was formerly an important breeding site for *Phoenicopterus chilensis* and *Larus cirrocephalus* which nested on islands now submerged by the rising water levels (1,000-1,500 *P. chilensis* and 4,000-5,000 *L. cirrocephalus*). A wide variety of other species occur in smaller numbers, and "thousands" of *Steganopus tricolor* have been recorded.
Other fauna: No information.
Threats: None at present.
Research and conservation: A proposal has recently been made for the establishment of a Provincial Reserve.
Source: Manuel Nores, Dario Yzurieta, Samuel Narosky and Sergio A. Salvador.
Criteria for inclusion: 1b & 3a.

Rio Dulce Marshes (19)

Location: 29°40'-30°30'S, 62°12'-63°20'W; north of Mar Chiquita, Cordoba Province.
Area: 500,000 ha.
Altitude: 70m.
Province and type: 8.21.4/8.25.7; 09, 11, 12, 14 & 16.
Site description: A vast system of riverine marshes, permanent and seasonal shallow fresh to brackish lakes and marshes, and seasonally flooded grassland along the lower Rio Dulce. The principal lakes are Laguna de los Patos, L. Palma, L. de las Tortugas and L. Mistoles. Extensive areas are flooded to a depth of 0.5m during the wet season; during the dry season, salinities increase and bare salt flats are exposed.
Principal vegetation: Both freshwater and brackish marsh vegetation, with small patches of forest on higher ground.
Land tenure: Mainly privately owned.
Protection: A small part of the marshes is included within the Mar Chiquita Provincial Reserve; the remainder is unprotected.
Land use: A little cattle ranching, hunting and fishing.
Waterfowl: A very important breeding area for a wide variety of species, and an important passage and "wintering" area for Nearctic shorebirds. Peak counts of breeding birds in recent years have included 2,000-3,000 *Phalacrocorax olivaceus*, 700-800 *Egretta alba*, 300,000-400,000 *Egretta thula*, 800-1,000 *Euxenura maguari*, 300,000-400,000 *Plegadis chihi*, 1,500-2,000 *Phoenicopterus chilensis*, 300-500 *Anas georgica*, 1,000-1,500 *A. platalea*, 800-1,000 *Netta peposaca*, 2,000-3,000 *Fulica armillata*, 6,000-8,000 *F. leucoptera*, 100-150 *Nycticryphes semicollaris*, 6,000-8,000 *Himantopus himantopus* and

200,000-300,000 *Larus maculipennis*. The area is rich in Rallidae, including *Porzana flaviventer*, *Laterallus spilopterus* and *Coturnicops notata*. Eleven species of Nearctic shorebirds have been recorded including 400-500 *Tringa melanoleuca*, 600-800 *Calidris fuscicollis*, 200-300 *C. bairdii*, 800-1,000 *Micropalama himantopus*, 200-250 *Limosa haemastica* and 8,000-10,000 *Steganopus tricolor*. Up to 100 *Coscoroba coscoroba* and a small number of *Cygnus melancoryphus* occur as winter visitors from the south.

Other fauna: The Coypu *Myocastor coypus* is common.

Threats: A dam on the Rio Hondo accelerates dessication of the marshes during the dry season and probably influences flooding during the rainy season.

Research and conservation: A number of ornithological surveys have been conducted since 1973 by Nores and Yzurieta.

References: Nores & Yzurieta (1980a).

Source: Manuel Nores and Dario Yzurieta.

Criteria for inclusion: 123.

Laguna Mar Chiquita (20)

Location: 30°45'S, 62°30'W; 150 km ENE of Cordoba, Cordoba Province.

Area: 200,000 ha.

Altitude: 70m.

Province and type: 8.21.4/8.25.7; 14.

Site description: A very large permanent highly saline lake, up to 4m deep, with some small islands, and brackish marshes at the mouths of rivers entering the lake. The delta marshes of the Rio Segundo are particularly extensive. In normal years, the level of the lake drops about 50 cm during the dry season. During a period of exceptional flooding starting in 1977, the lake level rose considerably; islands important for nesting birds were inundated and the salinity decreased. This produced a marked decline in the abundance and diversity of species.

Principal vegetation: Most of the lake is devoid of vegetation, but there are marshes of *Typha* and *Scirpus* spp, and riverine thickets of *Tamarix galica*, at river mouths. In a region of halophytic steppe and xerophytic woodland.

Land tenure: State owned.

Protection: Within the Mar Chiquita Provincial Reserve.

Land use: A little boat traffic.

Waterfowl: The lake itself is rather poor for birds, but the delta marshes, particularly of the Rio Segundo, are extremely important for waterfowl of a wide variety of species, especially Nearctic migrants. Peak counts of breeding birds in recent years have included 400-500 *Rollandia rolland*, 2,000-3,000 *Phalacrocorax olivaceus*, 3,000-4,000 *Bubulcus ibis*, 2,000-3,000 *Plegadis chihi*, 5,000-6,000 *Phoenicopterus chilensis*, 250-300 *Anasbahamensis*, 700-1,000 *A. cyanoptera*, 4,000-5,000 *A. platalea*, 250-300 *Netta peposaca*, 800-1,000 *Fulica armillata*, 2,000-3,000 *F. leucoptera*, 2,500-3,000 *Himantopus himantopus*, 400-500 *Larus cirrocephalus*, 200,000-300,000 *L. maculipennis*, 150-200 *Gelochelidon nilotica* and 80-100 *Sterna trudeaui*. Sixteen species of Nearctic shorebird have been recorded including up to 100 *Pluvialis dominica*, 15,000 *Tringa flavipes*, 15,000 *Calidris fuscicollis*, 200 *Micropalama himantopus*, 600 *C. melanotos* and 500,000 *Steganopus tricolor*. The lake is of considerable interest for the number of typically coastal species which occur in small numbers at this inland sea on migration, e.g. *Arenaria interpres*, *Calidris canutus*, *C. alba*, *C. pusilla* and *Sterna hirundo*.

Other fauna: Mammals include *Myocastor coypus*.

Threats: None, other than occasional exceptional flooding.

Research and conservation: Regular ornithological surveys have been conducted since 1973 by Nores and Yzurieta.

References: Nores & Yzurieta (1975, 1979, 1980a & 1983a).

Source: Manuel Nores and Dario Yzurieta.
Criteria for inclusion: 123.

Cañada de los Tres Arboles and Los Morteros (21)

Location: 30°50'S, 62°00'W; between Seeber and Morteros, Cordoba Province.
Area: 15,000 ha.
Altitude: 80-100m.
Province and type: 8.21.4; 13 & 16.
Site description: Temporary shallow freshwater ponds and marshes, and extensive areas of seasonally flooded grassland and arable land, to the southeast of Mar Chiquita. The area dries out completely during the dry season.
Principal vegetation: Mainly flooded grassland, with some *Scirpus* marshes.
Land tenure: Privately owned.
Protection: None.
Land use: Agriculture and hunting.
Waterfowl: Very important as a feeding area for large numbers of waterfowl during the wet season (the non-breeding season), and an important breeding area for several species. Maximum counts include 500-600 *Bubulcus ibis*, 300,000-400,000 *Plegadis chihi*, 800-1,000 *Dendrocygna bicolor*, 800-1,000 *D. viduata*, 400-500 *Anas bahamensis*, 250,000-300,000 *A. georgica*, 150,000-200,000 *Netta peposaca*, 8,000-10,000 *Fulica leucoptera*, and smaller numbers of *Phoenicopterus chilensis*, *Sarkidiornis melanotos*, *Heteronetta atricapilla* and six species of Nearctic shorebirds.
Other fauna: The Coypu *Myocastor coypus* occurs.
Threats: None at present.
Source: Manuel Nores, Dario Yzurieta and Sergio A. Salvador.
Criteria for inclusion: 1a.

Laguna Ludueña (22)

Location: 31°15'S, 63°32'W; 60 km east of Cordoba, Cordoba Province.
Area: 30 ha.
Altitude: 150m.
Province and type: 8.25.7; 12.
Site description: A permanent shallow freshwater lake and associated marshes in the valley of the Rio Primero, subject to considerable fluctuations in water level.
Principal vegetation: The aquatic vegetation is dominated by *Scirpus* sp and *Pistia* sp. The lake is in an area of rolling semi-arid shrubland.
Land tenure: Privately owned.
Protection: No hunting is allowed in the area.
Land use: A little cattle ranching and fishing.
Waterfowl: An interesting area because of the wide diversity of waterfowl which occur; fifty species of waterfowl have been recorded. Breeding species include *Ixobrychus involucris*, *Oxyura vittata*, *O. dominica*, *Heteronetta atricapilla*, *Rallus maculatus*, *Porphyrula martinica*, three species of *Fulica*, *Nycticryphes semicollaris* and *Himantopus himantopus*.
Other fauna: *Myocastor coypus* occurs.
Threats: None.
Research and conservation: The avifauna has been studied by Nores and Yzurieta since 1977.
Source: Manuel Nores and Dario Yzurieta.
Criteria for inclusion: 2b & 3a.

Laguna de Pocho (23)

Location: 31°25'S, 65°11'W; 90 km west of Cordoba, Cordoba Province.
Area: 50 ha.
Altitude: 900m.
Province and type: 8.25.7; 12.
Site description: A semi-permanent shallow freshwater lake, up to 2m deep, and associated marshes, subject to wide fluctuations in water level and drying out in exceptionally dry years.
Principal vegetation: Marshes of *Scirpus* sp.
Land tenure: Privately owned.
Protection: None.
Land use: None.
Waterfowl: An important breeding area for waterfowl, including *Rollandia rolland*, nine species of Anatidae, three species of *Fulica*, *Nycticryphes semicollaris*, and *Himantopus himantopus*.
Other fauna: No information.
Threats: None at present.
Research and conservation: Studies of the avifauna have been carried out by Nores and Yzurieta since 1974.
References: Nores & Yzurieta (1980a).
Source: Manuel Nores and Dario Yzurieta.
Criteria for inclusion: 2b & 3a.

Lagunas de Etruria (24)

Location: 32°53'S, 63°13'W; 50 km south of Villa Maria, Cordoba Province.
Area: 250 ha.
Altitude: 160m.
Province and type: 8.25.7/8.31.11; 12 & 16.
Site description: A complex of small permanent shallow freshwater lakes and marshes, and seasonally flooded grassland, along the Arroyo Chazon.
Principal vegetation: Marshes with *Scirpus* and *Typha* spp.
Land tenure: Privately owned.
Protection: None.
Land use: Cattle ranching, hunting and sport fishing.
Waterfowl: An important breeding and passage area for waterfowl. Peak counts in recent years have included 1,500-2,000 *Bubulcus ibis*, 120-150 *Euxenura maguari*, 3,000-5,000 *Plegadis chihi*, 400-500 *Phoenicopterus chilensis*, 800-1,000 *Dendrocygna bicolor*, 800-1,000 *D. viduata*, 80-100 *Coscoroba coscoroba*, 80-100 *Cygnus melancoryphus*, 3,000-5,000 *Anas georgica*, 800-1,000 *Netta peposaca*, 80-100 *Heteronetta atricapilla*, and up to 10,000 *Fulica* of three species. Eight species of Nearctic shorebirds have been recorded, including up to 2,000 *Pluvialis dominica*.
Other fauna: The Coypu *Myocastor coypus* occurs.
Threats: None at present.
Research and conservation: Sergio Salvador has conducted studies in the area since 1978.
References: Salvador (1983).
Source: Manuel Nores and Sergio A. Salvador.
Criteria for inclusion: 2b & 3a.

Cañada Santa Lucia (25)

Location: 33°08'S, 61°57'W; 140 km ESE of Villa Maria, Cordoba Province.
Area: 3,300 ha.
Altitude: 80m.
Province and type: 8.31.11; 14.

Site description: Two permanent shallow saline lakes, up to 2.5m deep, with some associated brackish marshes. There is little fluctuation in water level.
Principal vegetation: Brackish marshes with *Distichlis scoparia.*
Land tenure: Privately owned.
Protection: None.
Land use: Sport fishing.
Waterfowl: In March 1976, 32 species of waterfowl were present, including 3,000-4,000 *Plegadis chihi*, 250-300 *Calidris fuscicollis* and 4,000-5,000 *Larus maculipennis.*
Other fauna: No information.
Threats: None.
Source: Manuel Nores and Dario Yzurieta.
Criteria for inclusion: 3a.

Rio Saladillo Marshes (26)

Location: 33°25'S, 62°55'W; 110 km SSE of Villa Maria, Cordoba Province.
Area: 15,000 ha.
Altitude: 100m.
Province and type: 8.31.11; 12, 13 & 16.
Site description: A complex of about twenty shallow freshwater lakes, up to 3m deep, seasonal fresh to brackish marshes, and large areas of seasonally flooded grassland along the Rio Saladillo. Most of the lakes retain water throughout the dry season, but the marshes dry out completely.
Principal vegetation: *Scirpus* spp, *Typha* sp, *Distichlis scoparia*, various Chenopodiaceae in brackish areas, and small clumps of *Geoffroea decorticans* and *Tamarix galica.*
Land tenure: Privately owned.
Protection: None at present, but the owners do not generally allow hunting.
Land use: A little cattle ranching, hunting and fishing.
Waterfowl: Probably the most important breeding area for waterfowl in Cordoba Province, and an important "wintering" area for Nearctic shorebirds. Censuses of breeding birds have included up to 1,000 *Rollandia rolland*, 5,000 *Bubulcus ibis*, 40 *Euxenura maguari*, 20,000 *Plegadis chihi*, 200 *Coscoroba coscoroba*, 250 *Cygnus melancoryphus*, 500 *Heteronetta atricapilla*, 200 *Himantopus himantopus*, 8,000 *Fulica* of three species, 700 *Netta peposaca*, and 20,000 *Larus maculipennis*, 1,500 *Anas georgica*, 500 *Anas versicolor*, and 500 *Anas platalea.* Counts of Nearctic shorebirds have included 100 *Tringa melanoleuca*, 150 *Tringa flavipes*, 600 *Micropalama himantopus.*1,000 *Calidris fuscicollis*, 500 *Calidris bairdii*, and 300 *Calidris melanotos.*
Other fauna: The Coypu *Myocastor coypus* occurs.
Threats: There is a proposal to build a dam on the Rio Saladillo which would drastically reduce the extent of the marshes.
Research and conservation: There is a proposal to create a Provincial Nature Reserve or National Park in the area. Nores, Yzurieta and Miatello have conducted a number of ornithological surveys in the area, particularly in 1973 and 1974.
References: Nores & Yzurieta (1980a).
Source: Manuel Nores, Dario Yzurieta and Rodolfo Miatello.
Criteria for inclusion: 123.

Laguna La Margarita (27)

Location: 34°25'S, 64°00'W; 140 km SSE of Rio Cuarto, Cordoba Province.
Area: 500 ha.
Altitude: 150m.
Province and type: 8.25.7/8.31.11; 12.
Site description: A permanent shallow freshwater lake, up to 3m deep, with abundant aquatic vegetation, and subject to some fluctuation in water level.
Principal vegetation: *Scirpus* and *Myriophyllum* spp.

Land tenure: Privately owned.
Protection: No habitat protection, but hunting is prohibited.
Land use: Sport fishing.
Waterfowl: A very important breeding area for some waterfowl. Counts conducted in 1974 and 1977 included up to 5,000 *Rollandia rolland*, 2,000 *Podiceps occipitalis*, 50 *Theristicus (caudatus) melanopis* (non-breeding visitor), 1,500 *Plegadis chihi*, 3,000 *Anas georgica*, 40 *Oxyura vittata*, 5,000 *Fulica* of three species and 10,000 *Larus maculipennis*.
Other fauna: No information.
Threats: Destruction of aquatic vegetation by fishermen.
Source: Manuel Nores, Dario Yzurieta and Rodolfo Miatello.
Criteria for inclusion: 2b.

Lakes in Southwestern Cordoba Province (28)

Location: 34°45'S, 64°45'W; 180 km SSW of Rio Cuarto, Cordoba Province.
Area: 4,500 ha.
Altitude: 200m.
Province and type: 8.25.7; 14.
Site description: A complex of permanent shallow saline lakes, up to 2.5m deep, with little fluctuation in water level and little aquatic vegetation.
Principal vegetation: Some *Myriophyllum* sp; in a region of semi-arid woodland and scrub.
Land tenure: Privately owned.
Protection: None.
Land use: Sport fishing.
Waterfowl: An important wintering area, particularly for grebes Podicipedidae and coots *Fulica* spp. Counts made in the mid 1970s included up to 5,000 *Rollandia rolland*, 1,500 *Podiceps occipitalis*, 300 *Phoenicopterus chilensis*, 1,000 ducks, 25,000 *Fulica armillata* and 25,000 *F. leucoptera*.
Other fauna: No information.
Threats: None known.
References: Nores & Yzurieta (1980a).
Source: Manuel Nores and Dario Yzurieta.
Criteria for inclusion: 1a and 3a.

Laguna del Viboron (29)

Location: 32°53'S, 68°36'W; 20 km east of Mendoza, Mendoza Province.
Area: 38 ha.
Altitude: 650m.
Province and type: 8.25.7; 12.
Site description: A small permanent freshwater lake, up to 1.5m deep, with wide fluctuations in water level and abundant aquatic vegetation. One of the few significant wetlands in Mendoza Province.
Principal vegetation: Marshes dominated by *Scirpus* spp; in a region of halophytic steppe with Chenopodiaceae.
Land tenure: Privately owned.
Protection: None.
Land use: Sport fishing.
Waterfowl: Little quantitative information is available; thirty-six species of waterfowl have been recorded.
Other fauna: No information.
Threats: The waters of the Arroyo Leyes, the main river feeding the lake, are utilized for irrigation.
References: Contreras & Fernandez (1980).
Source: Manuel Nores.
Criteria for inclusion: 2b & 3a.

Berisso Marshes (30)

Location: 34°50'S, 57°52'W; northeast of La Plata, Buenos Aires Province.
Area: 1,000 ha.
Altitude: 0m.
Province and type: 8.31.11; 07, 13 & 17.
Site description: A complex of small permanent artificial ponds, up to 1m deep, with natural characteristics; freshwater marshes; and estuarine marshes along the shore of the adjacent Rio de la Plata.
Principal vegetation: Marshes with *Typha* and *Eichhornia* spp.
Land tenure: A mixture of state and private ownership.
Protection: None.
Land use: None.
Waterfowl: The area supports a very diverse avifauna, and is especially rich in Rallidae (11 species including *Laterallus melanophaius* and *L. leucopyrrhus*), shorebirds, and Laridae. *Phoenicopterus chilensis* is common, and up to 100 *Cygnus melancoryphus* have been recorded.
Other fauna: No information.
Threats: None known.
References: Klimaitis (undated).
Source: Manuel Nores, Juan F. Klimaitis and Samuel Narosky.
Criteria for inclusion: 2b.

Laguna de Lobos (31)

Location: 35°16'S, 59°06'W; 90 km SSW of Buenos Aires, Buenos Aires Province.
Area: 200 ha.
Altitude: 30m.
Province and type: 8.31.11; 12 & 13.
Site description: Permanent shallow freshwater lake, up to 3m deep, and seasonal marshes, with abundant aquatic vegetation.
Principal vegetation: Marshes with *Scirpus* and *Typha* spp; in the pampas.
Land tenure: Privately owned.
Protection: None.
Land use: Little human activity.
Waterfowl: An important area for breeding waterfowl, particularly Ardeidae, Anatidae and Rallidae. *Coscoroba coscoroba* and *Cygnus melancoryphus* are common winter visitors, and several species of Nearctic shorebirds occur in significant numbers in the austral summer.
Other fauna: The Coypu *Myocastor coypus* occurs.
Threats: None known.
References: Fraga (undated).
Source: Manuel Nores and Rosendo Fraga.
Criteria for inclusion: 2b & 3a.

Laguna Las Perdices and Laguna del Monte (32)

Location: 35°28'S, 58°49'W; 90 km south of Buenos Aires, Buenos Aires Province.
Area: Laguna Las Perdices 832 ha; L. del Monte 400 ha.
Altitude: 20-25m.
Province and type: 8.31.11; 12.
Site description: Two permanent shallow lakes, 2-3m deep, and associated marshes. Las Perdices is brackish; del Monte is fresh. The two lakes are connected by a canal, the flow from del Monte to Las Perdices being controlled by a sluice. Water from Las Perdices then drains

via a series of smaller lakes into the Rio Salado. Water levels in the lakes fluctuate slightly according to local rainfall.

Principal vegetation: There are extensive marshes of *Scirpus californicus* at both lakes. Other aquatic plants at Las Perdices include *Ceratophyllum demersum, Azolla* spp, *Lemna* sp, *Ricciocarpus* sp and *Myriophyllum brasiliensis.*

Land tenure: Las Perdices is largely privately owned (20% state owned); del Monte is privately owned.

Protection: None.

Land use: A considerable amount of sport fishing, principally for *Hoplias malabaricus*; some hunting of waterfowl and Coypus; water sports; and reed-cutting for basket-weaving.

Waterfowl: An important area for breeding, passage and wintering waterfowl of a wide variety; over 75 species have been recorded, including 14 species of Nearctic shorebirds.

Other fauna: The Coypu *Myocastor coypus* occurs. The fishes, amphibians and reptiles have been well documented, and are listed by Rozenberg.

Threats: The principal threat to the area is eutrophication and increased sedimentation resulting from the inflow of domestic sewage. There is also some industrial pollution, considerable disturbance from sport fishing and water sports, and collection of birds' eggs for human consumption.

Research and conservation: A project proposal has recently been prepared by the Municipal Authorities and the Camara de Diputados de Buenos Aires, on the basis of a recommendation made by local conservationists, to create an educational nature reserve (Reserva Natural Integral de Acceso Restringido).

References: Rozenberg (undated).

Source: Laura S. Rozenberg, Jorge Rodriguez Mata, Manuel Nores, Ricardo Banchs and Samuel Narosky.

Criteria for inclusion: 2b & 3a.

Samborombon Bay, Punta Rasa and Campos del Tuyu (33)

Location: 35°30'-36°22'S, 56°45'-57°23'W; northwest of San Clemente del Tuyu, Buenos Aires Province.

Area: c.100,000 ha.

Altitude: 0-4m.

Province and type: 8.31.11; 02, 06, 07, 13 & 16.

Site description: Samborombon Bay is a large bay along the south shore of the Rio de la Plata estuary with extensive intertidal mudflats, tidal salt marshes and network of tidal creeks. The bay is backed by a belt of coastal sand dunes and broad strip of seasonally flooded marshes and low-lying grassland, dissected by numerous slow-flowing streams. The area has remained relatively isolated and undisturbed.

Principal vegetation: *Salicornia* sp, *Spartina* sp, *Zizaniopsis brasiliensis, Juncus acutus, Distichlis* sp, with some *Scirpus californicus* and *Typha angustifolia.*

Land tenure: Mainly privately owned; the Military own the Punta Rasa area.

Protection: Unprotected except for a private reserve in the southern part of the Campos del Tuyu (3,500 ha, with a 4,000 ha buffer zone; established in 1979 to protect a population of the Pampas Deer, and administered by FVSA), and a small Provincial Reserve in the north. FVSA has maintained a warden (agente de conservacion) at Punta Rasa since the end of 1984.

Land use: Cattle ranching on the grasslands; fishing, water sports and other recreation along the coast.

Waterfowl: A very important passage and wintering area for migratory shorebirds, including Patagonian species in the austral winter and Nearctic species in the austral summer. The largest concentrations occur at the south end of the bay, in the Punta Rasa area. The freshwater marshes and wet meadows are also important for wintering *Theristicus (c) melanopis, Plegadis chihi, Chauna torquata, Phoenicopterus chilensis*, both species of swans, ducks and coots *Fulica* spp. The shorebirds of the area have been well documented by Myers & Myers (1979). The principal species include *Pluvialis squatarola, P. dominica* (abundant), *Charadrius falklandicus, C. modestus, Eudromias ruficollis, Tringa melanoleuca, T. flavipes, Calidris alba, C. canutus* (flocks of up to 100), *C. fuscicollis* (abundant), *C. melanotos, Micropalama himantopus, Tryngites subruficollis, Limosa haemastica* (up to 3,000 during migration), *Steganopus tricolor* and the seedsnipe *Thinocorus rumicivorus*. A variety of Laridae occur, including up to 3,000 wintering *Sterna hirundo* at Punta Rasa, and *Rynchops niger* is common.

Other fauna: The Pampas Deer *Ozotoceros bezoarticus celer* population is one of the last in Buenos Aires Province. The Capybara *Hydrochoerus hydrochaeris* is common.

Threats: A general increase in human activities is rapidly changing this relatively unspoiled area. There is a project to construct a deepwater harbour, and there are plans to drain important portions of the marshes.

Research and conservation: A proposal has been made to establish a Provincial Reserve and perhaps eventually a Natural Monument at Punta Rasa, along with a Biological Station. The station could make use of the old naval buildings at Punta Rasa, and would be administered jointly by the FVSA and National Parks Service.

References: Olrog (1967); Myers & Myers (1979).

Source: Manuel Nores.

Criteria for inclusion: 123.

Chascomus Lakes (34)

Location: 35°35'S, 58°01'W; 100 km SSW of Buenos Aires, Buenos Aires Province.

Area: 150,000 ha.

Altitude: 20m.

Province and type: 8.31.11; 12.

Site description: A vast complex of permanent shallow freshwater lakes, up to 4m deep, and associated marshes, in the pampas. The numerous lakes, some of up to several thousand ha in extent, include Laguna Chascomus, L. Vitel, L. Manantiales and L. de la Tablilla. Most of the lakes have abundant aquatic vegetation, and relatively stable water levels.

Principal vegetation: Marshes of *Scirpus* and *Typha* spp.

Land tenure: Privately owned.

Protection: None.

Land use: A lot of sport fishing in the lakes; cattle ranching in the surrounding pampas.

Waterfowl: A very important area for breeding and wintering waterfowl, but few census data available. Up to 5,000 *Cygnus melancoryphus* have been recorded at Laguna Chascomus.

Other fauna: No information.

Threats: None at present.

Source: Manuel Nores and Sergio A. Salvador.

Criteria for inclusion: 1a, 2b & 3a.

Albufera Mar Chiquita (35)

Location: 37°38'S, 57°24'W; 40 km NNW of Mar del Plata, Buenos Aires Province.

Area: 5,500 ha.

Altitude: 0-3m.

Province and type: 8.31.11; 07.

Site description: A permanent shallow coastal saline lagoon with a connection to the sea and little vegetation.

Principal vegetation: Brackish marshes with *Distichlis* sp around the edges of the lagoon;some stands of *Typha* sp and *Scirpus* sp.

Land tenure: State owned.

Protection: None at present.
Land use: A considerable amount of fishing.
Waterfowl: An important wintering area for Anatidae and shorebirds; up to 500 *Coscoroba coscoroba*, 3,000 *Cygnus melancoryphus* and 2,000 *Rynchops niger* have been recorded. Also an important staging area in April for over 10,000 *Calidris fuscicollis*, and in October and November for *Limosa haemastica, Micropalama himantopus* and *Steganopus tricolor.* 600 *Phoenicopterus chilensis* were present in January 1982.
Other fauna: No information.
Threats: None known.
Research and conservation: There is a project for the establishment of a Provincial Reserve.
References: Morrison *et al* (1985).
Source: Manuel Nores, Sergio A. Salvador and J. Peterson Myers.
Criteria for inclusion: 1a & 3a.

Bahia Blanca (36)

Location: 38°48'-39°25'S, 61°50'-62°25'W; south of Bahia Blanca town, Buenos Aires Province.
Area: 200,000 ha.
Altitude: 0m.
Province and type: 8.31.11; 02, 03, 05, 06 & 07.
Site description: A vast estuarine system of several small rivers, with extensive intertidal mudflats, numerous low islands, sandy beaches, coastal sand dunes, and some brackish marshes.
Principal vegetation: No information.
Land tenure: No information.
Protection: None.
Land use: No information.
Waterfowl: Known to be a breeding area for *Phoenicopterus chilensis*, and thought to be an important migration stopover and "wintering area" for Nearctic shorebirds. In an aerial survey in January/February 1982, substantial numbers of *Calidris fuscicollis* were observed.
Other fauna: No information.
Threats: No information.
References: Morrison (1983a).
Source: Brian A. Harrington.
Criteria for inclusion: 0.

Bahia Union, Bahia Anegada and the Rio Colorado Estuary (37)

Location: 39°45'-40°40'S, 62°00'-62°28'W; 150 km south of Bahia Blanca, Buenos Aires Province.
Area: 240,000 ha.
Altitude: 0m.
Province and type: 8.31.11/8.25.7; 02, 03, 05, 06 & 07.
Site description: A vast shallow sea bay at the estuary of the Rio Colorado, with extensive intertidal mudflats and salt marshes, several small low islands, sandy beaches and some coastal sand dunes. The area includes Bahia San Blas at the south end of Bahia Anegada.
Principal vegetation: No information.
Land tenure: No information.
Protection: None.
Land use: No information.
Waterfowl: An important migration stopover and "wintering" area for Nearctic shorebirds; 1,140 *Limosa haemastica* and large numbers of *Calidris fuscicollis* were recorded during an aerial survey in January/February 1982. There are also breeding colonies of *Ardea cocoi. Phoenicopterus chilensis* (2,275 birds including 300-400 breeding pairs in January 1982), *Larus dominicanus* and *L. belcheri.*
Other fauna: No information.

Threats: No information.
References: Morrison (1983a); Morrison *et al* (1985).
Source: Fundacion Vida Silvestre Argentina.
Criteria for inclusion: 1b.

Laguna Blanca (38)

Location: 39°02'S, 70°21'W; 30 km southwest of Zapala, Neuquen Province.
Area: 1,700 ha.
Altitude: 1,276m.
Province and type: 8.37.12; 12.
Site description: A permanent freshwater lake, up to 6m deep, fed by small streams and with little aquatic vegetation. There is little fluctuation in water level, and the lake partially freezes over in winter.
Principal vegetation: Marshes with *Scirpus* sp; in a region of Patagonian steppe, with xerophytic vegetation of grasses *Stipa, Poa* and *Festuca* spp, and dwarf shrubs.
Land tenure: State owned.
Protection: Within the Laguna Blanca National Park (8,250 ha), and the Laguna Blanca National Reserve (3,000 ha). The Park was established in 1940, primarily to protect the large population of *Cygnus melancoryphus.*
Land use: There is some cattle ranching in the area, and a public road through the Park passes along the lake shore.
Waterfowl: An important area for breeding waterfowl. A census in January/February 1982 included 300 *Rollandia rolland*, 1,500 *Podiceps occipitalis*, 2,000-2,500 *Cygnusmelancoryphus*, 300 *Chloephaga picta*, 500 *Anas sibilatrix*, 1,000 *Anas platalea*, 800 *Fulica armillata*, 80 *Oxyura vittata*, and smaller numbers of five other species of ducks and several species of shorebirds.
Other fauna: No information.
Threats: Cattle grazing around the lake have destroyed some of the aquatic vegetation.
Research and conservation: A number of general studies have been conducted on the limnology of the lake, and the fauna and flora of the Park.
References: Santos Gollan (1951); Erize *et al* (1981); IUCN (1982).
Source: Manuel Nores and Dario Yzurieta.
Criteria for inclusion: 1c, 2b & 3a.

Lago Huechulafquen and other wetlands in Lanin National Park and Reserve (39)

Location: 39°07'-40°22'S, 71°10'-71°40'W; in Andes of western Neuquen Province, on Chilean border.
Area: 30,500 ha of wetlands including Lago Huechulafquen (12,000 ha).
Altitude: 850-1,200m.
Province and type: 8.10.2/8.37.12; 10, 12 & 19.
Site description: Lago Huechulafquen is a large very deep freshwater lake with a little aquatic vegetation. There are also some twenty smaller freshwater lakes including Lago Quillen (2,800 ha), L. Tromen (2,700 ha), L. Lolog (3,800 ha) and L. Lacar (4,500 ha); a number of fast-flowing mountain rivers and streams; and areas of Andean bog.
Principal vegetation: The Park and Reserve span the transition zone between the *Nothofagus* and *Araucaria* forests of the Andes and the Patagonian steppe to the east.
Land tenure: The Park is state-owned; the Reserve is partly state owned and partly private.
Protection: Within the Lanin National Park (194,600 ha) and Lanin National Reserve (184,400 ha) established in 1937.

Land use: Tourism and sport fishing.

Waterfowl: Like all oligotrophic lakes of this type in the Argentinian and Chilean Andes, the lakes are of relatively little importance for waterfowl. Characteristic species include *Podiceps major navasi, Theristicus (c) melanopis, Chloephaga poliocephala, Tachyeres patachonicus* and *Anas specularis.*

Other fauna: Mammals include the Southern River Otter *Lutra provocax* and Coypu *Myocastor coypus*; amphibians include *Rhinoderma darwini*; and fishes include *Galaxias* and*Haplochiton* spp.

Threats: There are a number of introduced mammals in the area, and there is a considerable amount of disturbance from sport fishing and hunting. The Southern River Otter has almost been exterminated by hunting in the past.

Research and conservation: Basic faunal and floral inventories have been conducted in the Park.

References: IUCN (1982).

Source: Manuel Nores and Sergio A. Salvador.

Criteria for inclusion: 2a and 3a.

Wetlands in Nahuel Huapi National Park and Reserve (40)

Location: 40°20'-41°35'S, 71°10'-71°75'W; in Andes near San Carlos de Bariloche, Neuquen and Rio Negro Provinces.

Area: 84,000 ha of wetlands.

Altitude: 720-1,000m.

Province and type: 8.10.2/8.37.12; 10, 12 & 19.

Site description: Lago Nahuel Huapi is a freshwater lake, 56,000 ha in area and up to 454m deep, with fringing marshes in sheltered bays. Other large lakes in the area include Lago Traful (7,200 ha), L. Espejo (3,800 ha) and L. Mascardi (3,600 ha). There are over 35 smaller freshwater lakes, numerous fast-flowing mountain rivers and streams, and areas of bog within the Park and Reserve.

Principal vegetation: In the transition zone between the temperate rain forests of the Andes (principally *Nothofagus* spp) and the xerophytic steppe of Patagonia to the east, with Valdiviano Forest around Puerto Blest.

Land tenure: The Park is state owned; the Reserve is partly state owned and partly private.

Protection: Within the Nahuel Huapi National Park (330,000 ha) and National Reserve (428,100 ha) established in 1934 (although some protection was afforded to the area as early as 1904).

Land use: Tourism and fishing. There is a considerable amount of boat traffic on L. Nahuel Huapi.

Waterfowl: A wide variety of waterfowl occur in rather small numbers, including typical Andean species such as *Podiceps major navasi, Chloephaga poliocephala, Anas specularis* and *Merganetta armata.* L. Nahuel Huapi supports one of the few freshwater colonies of *Phalacrocorax atriceps.*

Other fauna: The population of the Southern River Otter *Lutra provocax* occurring in this region is probably the only important self-sustaining population of this species left in the Argentinian lake district between 39°S and 43°S.

Threats: Uncontrolled forest fires, introduced mammals including the Mink *Mustela vison*, and grazing by domestic livestock are causing some problems. Lage Nahuel Huapi is being polluted by effluents from the city of San Carlos de Bariloche, and oil and garbage from boat traffic.

Research and conservation: A complete inventory of the fauna has been conducted in the Park (Plan Inventario, directed by M. Christie).

References: Contreras *et al* (1980); Erize *et al* (1981); IUCN (1982).

Source: Manuel Nores, Dario Yzurieta and Roberto Straneck.

Criteria for inclusion: 2a & 3a.

Rio Ñirihuau (41)

Location: 41°05'S, 71°09'W; 10 km east of San Carlos de Bariloche, Rio Negro Province.
Area: 1000 ha.
Altitude: 764m.
Province and type: 8.10.2; 10, 11 & 12.
Site description: Riverine marshes along the lower Rio Ñirihuau, from its mouth in Lago Nahuel Huapi 5 km upstream. The marshes flood in June/July creating a shallow lake which remains until February.
Principal vegetation: In the ecotone between grassy steppe with *Stipa speciosa* and bushy steppe with *Rosa moschata, Fabiana imbricata* and *Berberis buxifolia.*
Land tenure: A mixture of private and municipal ownership.
Protection: None.
Land use: Formerly cattle grazing, but the land has been heavily overgrazed and eroded, and will now support few animals. There are brick factories further upstream.
Waterfowl: The area is interesting for the variety of species of waterfowl which have been recorded, particularly during the migration seasons. These include Andean species, Patagonian species and Nearctic shorebirds.
Other fauna: No information.
Threats: Urban expansion, industrial development, road construction and pollution from the brick factories all pose threats to the area.
Research and conservation: The avifauna of the area has been studied by Mariano A. Gelain (1978-1983).
Source: Mariano A. Gelain.
Criteria for inclusion: 2b & 3a.

Wetlands in Los Alerces National Park and Reserve (42)

Location: 42°33'-43°10'S, 71°35'-72°05'W; in Andes west of Esquel, Chubut Province.
Area: 25,000 ha of wetlands.
Altitude: 400-2,280m.
Province and type: 8.37.12; 10, 12, 15 & 19.
Site description: Several large permanent freshwater lakes, up to 700m deep, and a hydroelectric dam which linked four former lakes and flooded over 1,000 ha of surrounding forest. Also numerous fast-flowing mountain rivers and streams, and Andean bogs. The principal lakes are Lago Futalaufquen (5,300 ha), L. Menendez (6,200 ha), L. Rivadavia (2,900 ha), and Futaleufu Dam (8,200 ha).
Principal vegetation: In a region of Andean-Patagonian forest with large stands of *Fitzroya cupressoides* and *Nothofagus* spp.
Land tenure: State owned.
Protection: Within the Los Alerces National Park (187,500 ha) and National Reserve (75,500 ha), established in 1937.
Land use: Tourism in the National Park; generation of hydroelectricity.
Waterfowl: A variety of southern Andean waterfowl occur, including *Theristicus (c) melanopis* and *Anas specularis.*
Other fauna: There is a tiny population of the Southern River Otter *Lutra provocax* in the area. Amphibians include *Bufo spinulosus, B. variegatus* and *Rhinoderma darwini*; and fishes include *Galaxias, Haplochiton, Patagonina* and *Percichthys* spp.
Threats: Forest fires, and a number of introduced mammals including the Mink *Mustela vison* have caused problems in the Park.
Research and conservation: Basic faunal and floral surveys, and studies of the impact of *Mustela vison* on the native fauna, have been conducted.
References: IUCN (1982).
Source: See references.
Criteria for inclusion: 2a & 3a.

Lakes in Western Chubut (43)

Location: 43°10'S, 70°25'W; near Esquel, Chubut Province.
Area: 6,000 ha.
Altitude: 750m.
Province and type: 8.26.8; 14.
Site description: Numerous saline lakes, freshwater springs and streams in a desertic region in the foothills of the Andes.
Principal vegetation: In a region of sparse semi-desertic steppe vegetation.
Land tenure: Privately owned in large estancias.
Protection: None.
Land use: Sheep grazing.
Waterfowl: An important breeding site for *Phoenicopterus chilensis*; the colony held 3,000pairs in 1971/72, and 5,000 pairs in 1972/73. Also an important breeding area for a variety of Anatidae, including *Cygnus melancoryphus*.
Other fauna: Guanaco *Lama guanacoi* occur in the area.
Threats: None known in the mid 1970s, but no recent information.
References: Muñoz & Muñoz (1975).
Source: See references.
Criteria for inclusion: 1c.

Wetlands in Perito Francisco P. Moreno National Park and Reserve (44)

Location: 47°53'S, 72°10'W; in the Andes in northwestern Santa Cruz Province, on the Chilean border.
Area: 17,500 ha of wetlands.
Altitude: 900-2,770m.
Province and type: 8.37.12; 10, 12 & 19.
Site description: A series of deep freshwater lakes, fast flowing rivers and streams, and bogs in a mountainous area with glaciated land forms. The principal lakes are Lago Belgrano, L. Burmeister and L. Nansen.
Principal vegetation: In a region of Andean-Patagonian forest dominated by *Nothofagus* spp, and Patagonian steppe.
Land tenure: State owned.
Protection: Within the Perito Francisco P. Moreno National Park (84,500 ha) and National Reserve (30,500 ha), established in 1937.
Land use: A remote and little disturbed area; there is some grazing by domestic livestock in the east.
Waterfowl: Little information; a variety of waterfowl characteristic of the southern Andes have been recorded.
Other fauna: The local seedsnipe *Attagis malouinus* occurs. A variety of mammals occur inthe region including the South Andean Huemul *Hippocamelus bisulcus*. Fishes include *Geotria, Patagonina, Galaxia* and *Percichthys* spp.
Threats: Some illegal hunting has been reported in the Park.
References: Erize *et al* (1981); IUCN (1982).
Source: See references.
Criteria for inclusion: 3a.

Laguna Quiroga (45)

Location: 48°25'S, 71°35'W; 220 km NNE of Calafate, Santa Cruz Province.
Area: 5,000 ha.
Altitude: 1,300m.
Province and type: 8.26.8; 12.
Site description: A large permanent freshwater caldera lake, said to be ice-free in winter.
Principal vegetation: Probably only submergent vegetation.

Land tenure: Privately owned.
Protection: None.
Land use: Some sheep grazing.
Waterfowl: No information available, but a potential wintering area for the Hooded Grebe *Podiceps gallardoi.*
Other fauna: No information.
Threats: None known.
Research and conservation: The lake has not as yet been surveyed, but the Fundacion Vida Silvestre Argentina plans to do so in the near future.
Source: Jon Fjeldsa.
Criteria for inclusion: 0.

Meseta de Strobel (46)

Location: 48°40'S, 71°20'W; 200 km NNE of Calafate, Santa Cruz Province.
Area: 100,000 ha.
Altitude: 800-1,200m.
Province and type: 8.26.8; 12 & 14.
Site description: A basaltic plateau area with some 540 small lakes, mostly maars and calderas, with some volanic rift lakes. The lakes vary considerably in their limnological characteristics; ranging in salinity from fresh to hypersaline and alkaline, and in depth from very shallow to 10m. Water levels are rather stable, and most lakes freeze over in winter. The largest lake is Laguna del Islote (or L. del Medio), a freshwater caldera lake of 900 ha at the western edge of the plateau; this apparently does not freeze over in winter.
Principal vegetation: About 60% of the lakes are almost covered with beds of *Myriophyllum elatinioides*; some have dense submergent *Zanichellia* and *Potamogeton*; and many have no vegetation other than phytoplankton. There are no emergent sedges.
Land tenure: Privately owned.
Protection: None.
Land use: Sheep grazing.
Waterfowl: An extremely important breeding and moulting area for waterfowl, particularly Podicipedidae, Anatidae and shorebirds; and much the most important area for *Podiceps gallardoi* hitherto discovered. In February 1984, over 1,250 *P. gallardoi* were observed, and the total population of the plateau was estimated at over 3,100 birds. The largest concentration was 729 birds, mainly failed breeders, at Laguna del Islote, which may well be an important wintering area for the species. Population estimates made on the basis of counts at Islote and 118 smaller lakes in February 1984 included 2,600 *Podiceps occipitalis*, 1,160 *Phoenicopterus chilensis*, 350 *Cygnus melancoryphus*, 3,700 *Chloephaga picta*, 2,500 *Tachyeres patachonicus*, 3,350 *Lophonetta specularioides*, 225 *Charadrius falklandicus*, 115 *Charadrius modestus* 18,900 *Anas sibilatrix*, 11,600 *Anas georgica*, 17,700 *Anas platalea*, and260 *Pluvianellus socialis.* Nearctic shorebirds included 250 *Calidris fuscicollis*, 980 *Calidris bairdii* and 430 *Steganopus tricolor.* It would appear that this region is the main late summer staging and moulting area for dabbling ducks in Santa Cruz Province. The large breeding population of *Pluvianellus* is also particularly noteworthy.
Other fauna: Laguna de Islote is rich in amphipods *Hyalella* and most have snails *Lymnaea diaphana.*
Threats: Overgrazing by sheep causes erosion of terrestrial habitats and prevents the formation of emergent vegetation along the lake margins. The diatomite deposits in some lakes might be subject to exploitation, but the area is still very remote and seldom visited.
Research and conservation: The Fundacion Vida Silvestre Argentina is carrying out a programme of research in the region. In February 1984, the area was surveyed ornithologically by Jon Fjeldsa, Niels Krabbe, P. Brehmer and S. Brehmer, who investigated 119 lakes.
Source: Jon Fjeldsa.
Criteria for inclusion: 123.

Lago Argentino, Lago Viedma and Los Glaciares National Park and Reserve (47)

Location: 49°20'-50°40'S, 72°45'-73°30'W; in southwestern Santa Cruz Province, on Chilean border.
Area: 250,000 ha.
Altitude: mainly 215 - 300m, Park extends up to 3,500m.
Province and type: 8.37.12; 10, 12, 16 & 19.
Site description: Lago Argentino (141,700 ha) and Lago Viedma (106,000 ha) are deep freshwater lakes in the Andean foothills, fed by numerous fast-flowing rivers and streams. There are several smaller lakes (500-1,000 ha), wet meadows and marshes in the area, and extensive glaciers, snow fields and bogs at higher elevations.
Principal vegetation: Some of the smaller lakes have *Scirpus* beds and abundant submergent vegetation. In a region of Andean-Patagonian forests dominated by *Nothofagus* spp, with Patagonian steppe to the east.
Land tenure: The Park is state owned; most of the National Reserve is state owned but there are some private holdings.
Protection: The western quarter of Lago Viedma, the western arms of Lago Argentino, and all the smaller lakes are included within Los Glaciares National Park (445,900 ha) and Reserve (154,100 ha), established in 1937. The National Park was designated as a World Heritage Site in 1981.
Land use: Tourism in the National Park. There are still several small settlements in the Reserve, with some cultivation and livestock.
Waterfowl: An important breeding area for waterfowl, particularly Podicipedidae and Anatidae. The main concentrations are at the smaller lakes, marshes and wet meadows adjacent to Lago Argentino. The common breeding species include *Chloephaga picta, Cygnus melancoryphus, Anas georgica, A. flavirostris, A. sibilatrix, A. platalea* and *Fulica armillata.* Other noteworthy species include *Podiceps major navasi, Theristicus (caudatus) melanopis, Chloephaga poliocephala, Anas specularis, Oxyura jamaicensis ferruginea* and *O. vittata.* The area is the southernmost breeding locality of the blackbird *Agelaius thilius.*
Other fauna: The Coypu *Myocastor coypus* occurs.
Threats: Uncontrolled forest fires have caused problems in the Park; there is some illegal hunting and locally overgrazing problems.
Research and conservation: Basic studies on the fauna and flora of the Park have been conducted by the Direccion General de Parques Nacionales.
References: IUCN (1982).
Source: Jon Fjeldsa.
Criteria for inclusion: 2b & 3a.

Meseta del Tobiano (48)

Location: 49°32'S, 72°10'W; 90 km north of Calafate, Santa Cruz Province.
Area: Area of plateau (aquatic and terrestrial systems) 12,500 ha.
Altitude: 850m.
Province and type: 8.26.8; 12, 13 & 14.
Site description: A group of about 40 small fresh and brackish lakes on a high plateau near Lago Viedma. The larger deeper lakes are permanent, but the smaller lakes dry out in summer.
Principal vegetation: The freshwater lakes have an abundant growth of *Myriophyllum elatinoides.* In a region of treeless Patagonian steppe.
Land tenure: Privately owned.
Protection: None.
Land use: None.
Waterfowl: An important breeding area for waterfowl, particularly Podicipedidae, Anatidae and coots *Fulica* spp. There is a population of about 150 pairs of *Podiceps gallardoi* confined to eight of the lakes, with most on Laguna Las Toscas (73 pairs), L. Encantada (28 pairs) and L. Ansiedad (21 pairs). *Phoenicopterus chilensis* is a common non-breeding visitor, and several species of Nearctic shorebirds occur, notably *Calidris fuscicollis* and *C. bairdii.*

Other fauna: No information.
Threats: None.
Research and conservation: The Fundacion Vida Silvestre Argentina has carried out avifaunal surveys and a programme for the protection of the *P. gallardoi* population which has included predator control, cross-fostering and captive rearing. In view of the recent discovery of a large and healthy population of *P. gallardoi* on the Meseta de Strobel, the necessity of such an intensive grebe management programme at the Meseta del Tobiano population is questionable.
References: Erize (1983); Johnson (1983); Nuechterlein & Buitron (1983).
Source: See references.
Criteria for inclusion: 2a.

Laguna Los Escarchados (49)

Location: 50°25'S, 71°33'W; 50 km east of Calafate, Santa Cruz Province.
Area: 150 ha.
Altitude: 700m.
Province and type: 8.26.8; 12.
Site description: A permanent freshwater lake; the water level drops considerably during summer, and the lake freezes in winter.
Principal vegetation: Extensive beds of *Myriophyllum elatinoides*. In a region of xerophytic steppe and scrub.
Land tenure: Privately owned.
Protection: The Fundacion Vida Silvestre Argentina established a Wildlife Reserve in agreement with the owners in 1979.
Land use: Sheep and cattle grazing.
Waterfowl: The type locality of the recently described Hooded Grebe *Podiceps gallardoi* and for some years thought to be the only breeding site for the species. The population was estimated at 140-150 birds in 1979, but numbers fluctuate widely, and there were only 28 birds (including 11 breeding pairs) in February 1984. A wide variety of other waterfowl breed or occur as non-breeding visitors. A census by Fjeldsa in February 1984 included 700 *Anas georgica*, 200 *Anas platalea*, 8 pairs of *Pluvianellus socialis*, 44 *Podiceps occipitalis*, 11 *Coscoroba coscoroba*, and many *Charadrius falklandicus*, *Charadrius modestus*, *Calidris fuscicollis* and *Calidris bairdii*.
Other fauna: The Least Seedsnipe *Thinocorus rumicivorus* is common; 700 were recorded in February 1984.
Threats: The Kelp Gull *Larus dominicanus* is reported to be a serious predator on Hooded Grebe chicks. In years of high water level, there is little growth of *Myriophyllum* and the small snail which constitutes the principal diet of Hooded Grebe chicks disappears.
Research and conservation: Since the discovery of the Hooded Grebe in the early 1970s, the lake has been visited by a large number of ornithologists and bird-watchers. The grebe has been studied in considerable detail and various measures for its conservation have been proposed, including control of predators, cross-fostering and captive rearing. It now seems that the stronghold of the grebe lies 200 km to the north, on the Meseta de Strobel, and that the small Escarchados population is a marginal population which is not self sustaining.
References: Rumboll (1974); Erize (1978, 1982 & 1983); Erize *et al* (1981); King (1981); Nuechterlein & Johnson (1981); Storer (1981a); Nuechterlein (1982); Bremer & Bremer (1983); Nuechterlein & Buitron (1983).
Source: Jon Fjeldsa and Manuel Nores.
Criteria for inclusion: 2a.

Wetlands between Los Escarchados and Calafate (50)

Location: 50°18'-50°20'S, 71°31'-71°55'W; 40 km east of Calafate, Santa Cruz Province.
Area: 70 ha.
Altitude: 700m.

Province and type: 8.26.8; 12.
Site description: Six small shallow fresh to slightly saline lakes, up to 5m deep, in arid eroded grassland. The lakes are as follows: Laguna Nevada (30 ha; fresh); three claypans near Laguna Nevada (total 10 ha; slightly saline); Laguna Blanquillo (10 ha; fresh); and Laguna Perdida (20 ha; fresh). The water levels fluctuate considerably according to local snowfall, and the claypans occasionally dry out. All freeze over in winter.
Principal vegetation: Extensive beds of *Myriophyllum elatinoides* in the three lakes, and some *Zanichellia* in the claypans. In a region of arid Patagonian steppe.
Land tenure: Privately owned.
Protection: None.
Land use: Sheep grazing.
Waterfowl: Similar to Laguna Los Escarchados, with a variety of breeding waterfowl, and some Nearctic shorebirds. The commoner breeding species include *Chloephaga picta, Anas georgica, A. platalea, Tachyeres patachonicus* and *Fulica armillata.* Small numbers of *Podiceps gallardoi* breed at Laguna Nevada (up to 40 birds) and Laguna Blanquillo (up to 27 birds), and non-breeding individuals occur on the claypans.
Other fauna: Brine shrimps *Artemia* sp occur in the claypans.
Threats: None.
Research and conservation: A number of ornithological surveys have been conducted by the Fundacion Vida Silvestre Argentina which is studying the area as part of its Hooded Grebe Project.
Source: Jon Fjeldsa.
Criteria for inclusion: 2a.

Lago Sarmiento and wetlands on the Meseta de Las Vizcachas (51)

Location: 50°25'-50°30'S, 71°50'-71°59'W; 30 km ESE of Calafate, Santa Cruz Province.
Area: c.550 ha.
Altitude: 750-1,200m.
Province and type: 8.26.8; 12 & 14.
Site description: Lago Sarmiento is a permanent shallow salt lake of 350 ha, with shores of gravel and boulders. The water level fluctuates widely, and the lake freezes over in winter. It lies on a basaltic plateau with six small freshwater volcanic lakes, totalling 200 ha, which also freeze over in winter, and have mainly rocky shores.
Principal vegetation: Some of the small lakes have beds of *Myriophyllum elatinoides*; the others lack aquatic vegetation. In a region of Patagonian steppe.
Land tenure: Privately owned.
Protection: None.
Land use: Sheep grazing and some horse rearing.
Waterfowl: Similar to Laguna Escarchados and other lakes in the region, but *Podiceps gallardoi* has not been recorded. Probably an important moulting area for Anatidae. The commoner species include *Chloephaga picta, Lophonetta specularioides, Anas georgica* and *A. platalea. Phoenicopterus chilensis* occurs at Lago Sarmiento, and up to 200 *Calidris fuscicollis* have been observed.
Other fauna: Brine Shrimps *Artemia* sp occur in Lago Sarmiento.
Threats: None known.
Research and conservation: Avifaunal surveys have been conducted by Fjeldsa.
Source: Jon Fjeldsa.
Criteria for inclusion: 3a.

El Tero Marshes (52)

Location: 50°35'S, 71°15'W; 75 km ESE of Calafate, Santa Cruz Province.
Area: 500 ha.
Altitude: 200m.

Province and type: 8.26.8; 09, 11, 12 & 13.
Site description: A complex of riverine marshes, shallow freshwater lakes, ponds and marshes, and rushy pastures; one of the few riverine marsh systems in Santa Cruz Province which has not been destroyed by sheep grazing.
Principal vegetation: Ponds and creeks with species of *Hydrocotyle, Hippuris, Caltha* and *Myriophyllum*; marshes with *Scirpus californicus.* In the Patagonian steppe.
Land tenure: Privately owned (Hacienda El Tero).
Protection: None.
Land use: Some grazing, mainly by horses.
Waterfowl: A variety of species typical of the region occur, including "hundreds" of *Chloephaga picta* and *Cygnus melancoryphus.* A pair of *Podiceps gallardoi* has nested on a nearby lake. The wet pastures are probably important for migrant shorebirds.
Other fauna: Passerines and presumably other fauna characteristic of tall grassland still occur at El Tero. This fauna has been exterminated over much of Patagonia as a result of overgrazing.
Threats: Overgrazing by sheep, leading to soil erosion, increased turbidity of rivers and streams, and the siltation of lake basins, may result in the degradation of this area in the same way that it has destroyed most other riverine marsh systems in the Province.
Research and conservation: The Fundacion Vida Silvestre Argentina is discussing with the owners the possibility of conserving the area. Research into the management needs of this threatened habitat type is urgently required.
Source: Jon Fjeldsa.
Criteria for inclusion: 2b & 3a.

Valdes Peninsula (53)

Location: 42°30'S, 64°00'W; coastal Chubut Province.
Area: Area of wetlands unknown; 300 km of coastline on two major bays.
Altitude: 0-100m.
Province and type: 8.25.7; 01, 04, 05, 06 & 07.
Site description: The Valdes Peninsula is a hilly peninsula protruding 100 km out into the Atlantic Ocean. The principal wetland areas are Golfo San Jose on the north side of the peninsula, Golfo Nuevo on the south side, and a series of brackish lagoons on the east coast. G. San Jose and G. Nuevo are shallow sea bays with extensive intertidal mudflats and sandy beaches.
Principal vegetation: In a region of dry thorn scrub and steppe.
Land tenure: No information.
Protection: The Golfo San Jose is a Provincial Reserve (Parque Marino Provincial) established in 1974. The Reserve includes a 100m strip of land surrounding the Gulf. There are also Provincial Reserves at Punta Norte in the north, Punta Piramides on Golfo Nuevo, Punta Delgada in the southwest, and Islas de los Pajaros.
Land use: No information.
Waterfowl: The intertidal mudflats and coastal lagoons comprise an important migration staging area and "wintering" area for Nearctic shorebirds. Up to 20,000 *Calidris canutus* have been recorded in April, and up to 10,000 *Calidris fuscicollis* and hundreds of *Limosa haemastica* have been observed in March/April and October/November.
Other fauna: The bays around the peninsula are important calving and mating areas for the Right Whale *Balaena glacialis. Orcinus orca, Otaria flavescens, Arctocephalus australis* and *Mirounga leonina* also occur, along with large breeding colonies of sea-birds.
Threats: No information.
References: Erize *et al* (1981); IUCN (1982); Morrison (1983a).
Source: See references.
Criteria for inclusion: 1a, 1b & 2b.

Punta Tombo (54)

Location: 44°03'S, 65°12'W; 90 km south of Trelew, Chubut.
Area: 50 ha.
Altitude: 0m.
Province and type: 8.25.7; 01, 04 & 05.
Site description: A peninsula of red volcanic rock with sand dunes, rocky shores and sand and pebble beaches, extending 3 km out into the Atlantic.
Principal vegetation: Some semi-arid grassland with scattered shrubs.
Land tenure: State owned.
Protection: Within the Punta Tombo Provincial Faunal Reserve.
Land use: A considerable amount of tourism.
Waterfowl: Of prime importance for its enormous colony of sea-birds (see below). Breeding waterfowl include *Podiceps major*, *Egretta alba*, *Tachyeres pteneres*, *Lophonetta specularioides*, *Haematopus palliatus*, *H. ater* and *Charadrius falklandicus*. A variety of Nearctic shorebirds including *Arenaria interpres*, *Calidris canutus*, *C. alba*, *C. fuscicollis* and *C. bairdii* occur on passage.
Other fauna: The peninsula supports the largest sea-bird colony on the Patagonian coast, with 2-3 million Magellanic Penguins *Spheniscus magellanicus*, large numbers of *Phalacrocorax magellanicus*, *P. bougainvillii*, *P. albiventer* and *Larus dominicanus*, and small numbers of *Catharacta skua*, *Leucophaeus scoresbii* and *Sterna hirundinacea*. There is also a large colony of the South American Sea-lion *Otaria flavescens*.
Threats: There is some disturbance from tourism, and a potential threat from oil pollution. A proposal has been made for the commercial exploitation of the large penguin colony, but this has been rejected, at least for the time being.
Research and conservation: A considerable amount of research has been conducted at the sea-bird colony, and the Animal Research and Conservation Center of the New York Zoological Society is involved in a wildlife conservation project at the site. An application has been made for the upgrading of the Reserve to a National Natural Monument.
References: Korschenewski (1969); Boswall & Pryterch (1972); Boswall (1973); Erize *et al* (1981); Scolaro *et al* (1981).
Source: Manuel Nores, Sergio A. Salvador and Samuel Narosky.
Criteria for inclusion: 2c & 3a.

Bahia Bustamente (55)

Location: 45°05'S, 66°20'W; 120 km NNE of Comodoro Rivadavia, Chubut Province.
Area: 35,000 ha.
Altitude: 0m.
Province and type: 8.26.8; 01, 04, 05 & 06.
Site description: A shallow sea bay with extensive intertidal mudflats, sandy beaches and some rocky shores.
Principal vegetation: No information.
Land tenure: No information.
Protection: None.
Land use: No information.
Waterfowl: A very important area for Nearctic shorebirds; particularly *Limosa haemastica*, *Calidris canutus* (up to 6,900), and *C. fuscicollis*.
Other fauna: No information.
Threats: No information. **Research and conservation:** Aerial censuses of shorebirds have been conducted.
References: Harrington & Morrison (1980a & 1980b); Morrison (1983a).
Source: See references.
Criteria for inclusion: 1a & 1b.

Golfo San Jorge from Caleta Olivia to Cabo Blanco (56)

Location: 46°47'S, 67°32'W to 47°13'S, 65°45'W; south of Comodoro Rivadavia, Santa Cruz Province.
Area: 160 km of coastline.
Altitude: 0m.
Province and type: 8.26.8; 01, 05 & 06.
Site description: A large sea bay with sandy beaches and an extensive intertidal zone of hard packed mud with a densely pitted surface, formed from dust blown off the Patagonian plains, and with a wealth of marine life including dense beds of mussels and rich algal growth.
Principal vegetation: Marine algae.
Land tenure: No information.
Protection: There is a Provincial Reserve at Cabo Blanco in the extreme south; otherwise unprotected.
Land use: No information.
Waterfowl: A very important area for Nearctic shorebirds, particularly *Limosa haemastica* (up to 550), *Calidris canutus* (up to 1,300), and *C. fuscicollis* (up to 7,500). Also an important wintering area for Patagonian shorebirds such as *Haematopus leucopodus* and *Charadrius modestus*, and for *Lophonetta specularioides*.
Other fauna: No information.
Threats: The development of an oil industry in this area may cause problems in the future.
Research and conservation: Aerial censuses of shorebirds have been carried out.
References: Harrington & Morrison (1980a & 1980b); Morrison (1983a).
Source: See references.
Criteria for inclusion: 1b.

The Rio Deseado Estuary (57)

Location: 47°45'S, 65°52'W; at Puerto Deseado, Santa Cruz Province.
Area: 9,000 ha.
Altitude: 0m.
Province and type: 8.26.8; 02, 03, 04 & 06.
Site description: The estuarine system of the Rio Deseado, with several small islands, intertidal mud shores, and a rocky headland with sea-cliffs to the south.
Principal vegetation: In a region of arid Patagonian shrubland and steppe.
Land tenure: No information.
Protection: The area was declared a Provincial Reserve in 1977, but the Reserve has never been properly instrumented.
Land use: No information.
Waterfowl: An important estuary for Nearctic shorebirds; 520 *Limosa haemastica* and 550 *Calidris canutus* were recorded during an aerial survey in January/February 1982. The area is also important for *Tachyeres* spp, *Lophonetta specularioides* and *Haematopus* spp.
Other fauna: There are large breeding colonies of sea-birds on the headland to the south of the estuary (Punta Norte), including the largest colony of *Phalacrocorax gaimardi* in Argentina.
Threats: No information.
References: Erize *et al* (1981); Morrison (1983a).
Source: See references.
Criteria for inclusion: 1b.

Bahia San Sebastian and Cabo Domingo (58)

Location: 53°00'-53°25'S, 68°03'-68°33'W; 80 km NNW of Rio Grande, Tierra del Fuego.
Area: 37,500 ha.
Altitude: 0m.
Province and type: 8.26.8; 01, 05 & 06.

Site description: A large shallow sea bay with extensive intertidal mudflats, hard mud shore and coastal sand dunes. The muddy shore continues southeast along the coast to the region of Cabo Domingo.
Principal vegetation: No information.
Land tenure: No information.
Protection: None.
Land use: No information.
Waterfowl: An important "wintering" area for Nearctic shorebirds, principally *Limosa haemastica* (6,000-8,000), *Calidris canutus* (up to 1,000) and *C. fuscicollis.*
Other fauna: No information.
Threats: No information.
Research and conservation: Several aerial and ground censuses of shorebirds have been conducted.
References: Harrington & Morrison (1980a & 1980b); Williams & Pringle (1982); Morrison (1983a).
Source: See references.
Criteria for inclusion: 1a & 1b.

The Rio Grande Estuary and nearby coasts (59)

Location: 53°48'S, 67°41'W; southeast from Rio Grande, on the Atlantic coast of Tierra del Fuego.
Area: 4,000 ha.
Altitude: 0m.
Province and type: 8.26.8; 02, 05 & 06.
Site description: The estuary of the Rio Grande with extensive intertidal mudflats, and the intertidal muddy shores and pebble beaches to the northwest and southeast, including the Punta Maria area, 35 km southeast of Rio Grande.
Principal vegetation: No information.
Land tenure: No information.
Protection: None.
Land use: No information.
Waterfowl: An important "wintering" area for Nearctic shorebirds, including over 5,000 *Calidris canutus*, several thousand *Calidris fuscicollis*, and smaller numbers of *Limosa haemastica* and *Calidris alba.*
Other fauna: No information.
Threats: No information.
Research and conservation: There have been several aerial and ground censuses of the shorebirds.
References: Harrington & Morrison (1980a & 1980b); Williams & Pringle (1982); Morrison (1983a).
Source: See references.
Criteria for inclusion: 1b.

Lago Fagnano and wetlands in Tierra del Fuego National Park (60)

Location: 54°50'S, 68°30'W; near Ushuaia, Tierra del Fuego.
Area: Over 60,000 ha.
Altitude: 0-1,000m.
Province and type: 8.37.12; 01, 04, 10, 12 & 19.
Site description: Lago Fagnano (at 150m) is a freshwater lake of about 60,000 ha fed by numerous fast-flowing streams. There are several much smaller lakes, peat bogs and extensive areas of bog in the surrounding hills. The nearby Beagle Channel coast is rocky.
Principal vegetation: In a region of humid *Nothofagus* forest with abundant mosses.
Land tenure: Land within the National Park is state owned.

Protection: 7,200 ha of Lake Fagnano, a portion of the Beagle Channel coast, and a number of small lakes, streams and bogs are included within the Tierra del Fuego National Park (63,000 ha), established in 1960.
Land use: Tourism and sport fishing in the National Park.
Waterfowl: A variety of breeding Anatidae including *Chloephaga hybrida, C. picta, C. poliocephala, Tachyeres pteneres, T. patachonicus* and *Anas specularis.*
Other fauna: The Southern River Otter *Lutra provocax* occurs in the Park, and there are large populations of Guanaco *Lama guanacoi* and sea-lions *Otaria flavescens.*
Threats: Introduced beavers *Castor canadensis* and rabbits *Oryctolagus cuniculus* are causing a problem in the Park.
References: Erize *et al* (1981); IUCN (1982).
Source: Manuel Nores and Roberto Straneck.
Criteria for inclusion: 2a & 3a.

BOLIVIA

INTRODUCTION

by **Eliana Flores**

Bolivia is situated in the central part of the South American continent. It has an area of 1,098,581km^2 and a population of some six million, of which about 55% live in rural areas.

Bolivia may be divided into three large regions:

a) The highlands of the Andes. The Andes split into two branches in northern Bolivia; the western branch (Ramal Occidental or Cordillera Volcanica) with an average height of 4,800m, and the eastern branch (Ramal Oriental) with an average height of over 5,000m. The Andean plateau between the two branches has an average height of 3,800m, and constitutes an enormous, almost level, inland drainage system with a number of large lakes and salt basins, notably Lake Titicaca, Lake Poopo and the salars of Uyuni and Coipasa. The region is characterized by its cold and dry climate, with rainfall concentrated in the summer months and varying in intensity from north to south.
b) The east slope of the Andes and sub-Andean ridges east of the Cordillera Oriental, at altitudes between 500 and 2,500m. The climate is mainly dry and temperate year round, or with dry winters and extremely hot summers, but in some valleys the climate is hot and humid.
c) The lowlands, including the humid plains of the Beni in the north, the plains of the Chaco in the south and the Brazilian Shield in the east, at altitudes between 180 and 500m. The northern lowlands are characterized by their high temperatures and ten to twelve months of rain, while the Chaco areas in the south have a hot climate with dry winters.

Bolivia includes parts of three of South America's great hydrographic basins. The Amazon basin accounts for 60% of the country, and includes the Madre de Dios, Beni, Mamore and Itenez rivers which flow into the Amazon via the Rio Madeira. The basin of the Plata occupies the southern and southeastern parts of the country, and includes the Paraguay, Pilcomayo and Bermejo rivers. The third basin is the closed system of the altiplano which includes Lake Titicaca and Lake Poopo, the Rio Desaguadero linking the two lakes together, Salar de Uyuni and Salar de Coipasa.

The wetlands of Bolivia include the following:
a) Wetlands in the high Andes, including 6,326 sq. km of lakes, 1,354 sq. km of lagoons, and 184 sq. km of rivers, reservoirs and other artificial water bodies.
b) Wetlands at intermediate elevations, limited to 21 sq. km of small lakes and reservoirs.
c) Wetlands in the lowlands, including over 4,711 sq. km of lakes, and rivers and streams of 1,101 sq. km.

The country has 12,179 sq. km of wetlands which are permanently flooded, and a further 12,012 sq. km of land which is flooded during the rainy season.

Institutional Base for Wetland Conservation and Research

Governmental

In the Ministerio de Asuntos Campesinos y Agropecuarios:

Centro de Desarrollo Forestal; responsible for protected areas such as Refuges, Reserves and National Parks.

Instituto Nacional de Fomento Lanero; since 1981, responsible for National Parks and National Reserves in the Altoandina Region.

In the Ministerio de Planeamiento y Coordinacion:

Direccion de Ciencia y Tecnologia; responsible for the coordination of research projects.

Non-governmental

In the Universidad Mayor de San Andres:

Instituto de Geodinamica y Limnologia, created in 1971.

Instituto de Ecologia, created in 1978 by an agreement between the Universidad Mayor de San Andres and the University of Gottingen, Federal Republic of Germany. One of its principal objectives is to support activities and initiatives directed towards the conservation of nature and the study of the ecology of the Beni Savanna.

In the Academia Nacional de Ciencias:

Museo Nacional de Historia Natural, created in 1980; its main objectives are to produce an inventory of the fauna and flora of Bolivia and to prepare scientific collections.

Estacion Biologica Beni, created in 1982; its objectives are to study the fauna and flora of the savanna and forest ecosystems.

Others

Organizacion Pro Defensa de la Naturaleza (PRODENA).
Sociedad Boliviana de Ecologia.
Instituto Geografico Militar.
Zoologico de Santa Cruz.

Progress in Wetland Conservation and Research

The Reserva Natural Lagunas de Beni y Pando was established in October 1981 for the protection of wetlands in the Departments of Beni and Pando, but the wetlands have never been afforded adequate protection. In the same way, the National Parks of Bellavista (established in 1946) and Isiboro-Secure (established in 1965) were created to protect drainage basins, but were never given adequate protection and have subsequently been partly deforested as a result of colonization and exploitation of timber. The Reserva Nacional Eduardo Avaroa was created in 1973 for the protection of James' Flamingo *Phoenicoparrus jamesi*, but it lacks efficient protection, and hunting and egg-collecting continue. The Reserva Nacional Ulla-Ulla, created in 1972 and designated a Biosphere Reserve in 1977, comes under the administration of the Instituto Nacional de Fomento Lanero, and benefits from a resident staff and adequate infrastructure. The Refugio de Vida Silvestre de Huancaroma, created in 1975, gives some protection to the Short-winged Grebe *Rollandia micropterum*. The Reserva Nacional Manuripi Heath, created in 1975, lacks protection; however, because of the inaccessibility of the area, the wildlife is in effect protected.

On 1 May 1984, the Centro de Desarrollo Forestal imposed a complete ban on the hunting of wild animals for one year, with a view to conducting population censuses of wildlife, setting guidelines for the management of wildlife resources and drawing up appropriate hunting regulations.

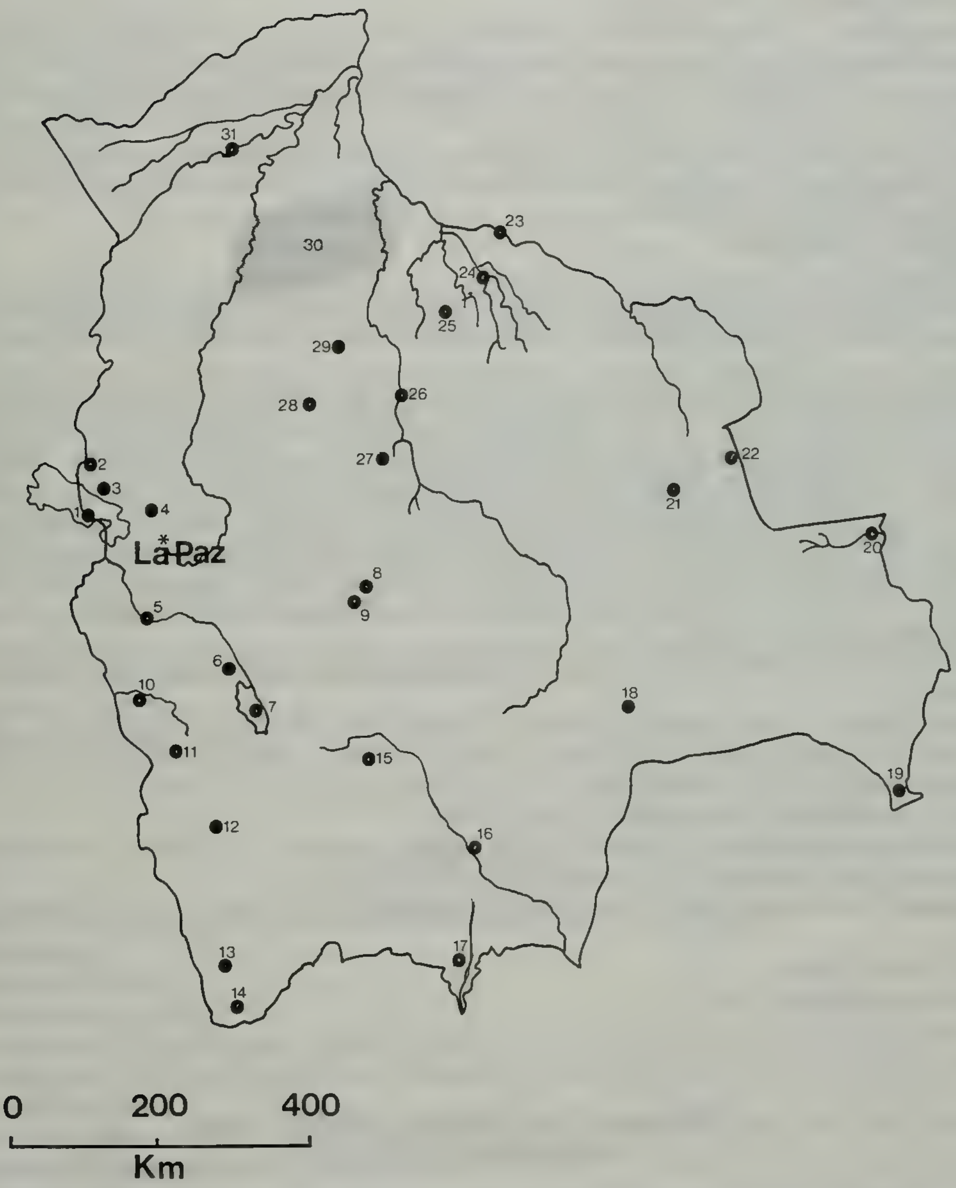
Few of the research programmes conducted in Bolivia have involved wetlands or waterfowl. Those which have include the following:

a) An inventory of the high Andean avifauna initiated by E. Flores at the Museo Nacional de Historia Natural in 1981.
b) Studies on the avifauna of the Reserva Nacional Ulla-Ulla by J. Cabot and P. Serrano at the Instituto Nacional de Fomento Lanero, under an agreement between the Ministerio de Asuntos Exteriores and the Servicio de Cooperacion de España. Various expeditions have also been organized to the Reserva Nacional de Fauna Altoandina Eduardo Avaroa.
c) A study of Ciconiidae at Espiritu, Department of Beni, by W. Hanagarth and M. O. Ribera.
d) A study of the limnology of Lake Titicaca and Lake Poopo, and a study of the geology of the salars, by the Instituto de Geodinamica y Limnologia and the French Office de la Recherche Scientifique et Technique Outre Mer (ORSTOM).

Major Threats to Wetlands and Waterfowl

The principal threats to wetlands and waterfowl in Bolivia are the lack of adequate protection, uncontrolled hunting and, in the case of flamingos, the collection of eggs.

BOLIVIA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WETLANDS

Site descriptions based on data sheets prepared by Eliana Flores of the Museo Nacional de Historia Natural, and contributions from Percy Baptista, Jose Cabot, H. E. M. Dott, Jon Fjeldsa, Werner Hanagarth, Raul Lara, Marco O. Ribera, Pilar Serrano and the Estacion Biologica de Doñana (Javier Castroviejo).

Lake Titicaca (1)

Location: 16°20'S, 68°45'W; on Peruvian border, La Paz Department.
Area: 830,000 ha in total; 369,000 ha in Bolivia.
Altitude: 3,810m.
Province and type: 8.47.14; 12 & 16.
Site description: A large permanent freshwater lake, up to 272m deep, on a high Andean plateau; formed in the centre of a tectonic basin. There are extensive areas of emergent aquatic vegetation in shallow bays, and adjacent areas of seasonally inundated puna grassland, but much of the shoreline is steep and rocky. The water level fluctuates by about one metre.
Principal vegetation: The dominant emergent around the shores and in water up to 3m deep is *Schoenoplectus tatora.* The lake is in the puna zone, with semi-arid steppe vegetation and sparsely vegetated rocky hillsides.
Land tenure: State owned.
Protection: None.
Land use: Hunting and fishing; cutting of reeds for boat-building and handicrafts; trout farming; local and international boat traffic; and grazing of domestic livestock in surrounding areas.
Waterfowl: An extremely important area for Andean waterfowl and Nearctic shorebirds. The commoner resident species include the very local Short-winged Grebe *Rollandia micropterum, R. rolland, Phalacrocorax olivaceus, Nycticorax nycticorax, Plegadis ridgwayi, Phoenicopterus chilensis* (a non-breeding visitor), *Chloephaga melanoptera, Anas flavirostris, A. georgica, A. puna, A. cyanoptera, Oxyura jamaicensis ferruginea, Gallinula chloropus, Fulica americana, Vanellus resplendens, Charadrius alticola, Himantopus himantopus* and *Larus serranus.* The commonest Nearctic shorebirds are *Pluvialis dominica*, which has been observed in huge numbers on migration, *Tringa melanoleuca, T. flavipes, Calidris bairdii, C. melanotos* and *Steganopus tricolor.*
Other fauna: The lake has a rich and diverse endemic fish fauna, with fourteen species of *Orestias.*
Threats: Pollution from domestic sewage is causing eutrophication in some bays; and nearby zinc, lead and magnesium mines could create a serious pollution problem in the future. Excessive fishing and the introduction of exotic fish species into the lake have caused a drastic decline in populations of the endemic fish species.
Research and conservation: A number of limnological studies and fisheries investigations have been carried out, particularly by UMSA-ORSTOM since 1974.
References: Niethammer (1953); Allen (1976); Hughes (1977); Carmouze *et al* (1977a, 1977b & 1981).
Source: Eliana Flores.
Criteria for inclusion: 123.

Wetlands in the Ulla-Ulla National Reserve and Biological Reserve (2)

Location: 14°45'-15°25'S, 69°00'-69°20'W; 200 km NNW of La Paz, La Paz Department.
Area: c.1,120 ha of lakes and marshes.
Altitude: 4,200-4,700m.

Province and type: 8.36.12; 10, 12, 17 & 19.
Site description: A wide diversity of interrelated wetland ecosystems in the high Andean puna zone; including edges of glaciers, small morraine lakes, larger freshwater lakes with abundant aquatic vegetation, peat bogs and bofedales with muddy areas, permanent and seasonal fast-flowing streams, and the Rio Suches, a relatively slow-flowing river. The principal lakes are Sorakocha (1 ha), Chojnakota (7 ha), Yokariakota (10 ha), Cololo (100 ha), and the Kello and Puyu-Puyu complex (300-600 ha). There are extensive muddy peat bog and bofedal systems between Laguna Kello and L. Puyu-Puyu, along the Rio Suches, and near the village of Ulla-Ulla. The latter are mostly artificial, being maintained by a system of low dykes. This irrigation system, which dates back to Inca times, is still being used. Water levels in the lakes and marshes fluctuate widely, and large areas dry out in winter (the dry season). The lakes are fed primarily by melting glaciers.
Principal vegetation: Lakes and marshes with species of *Elodea, Myriophyllum* and *Hydrocotyle*, various algae and Cyperaceae; bofedales with abundant *Distichia* sp. In the high Andean puna zone.
Land tenure: State owned.
Protection: Within the Ulla-Ulla National Reserve (137,800 ha) established in 1972, and Ulla-Ulla Biological Reserve (200,000 ha) established in 1977. The Biological Reserve is a Biosphere Reserve.
Land use: Llama and alpaca grazing; and trout fishing.
Waterfowl: Almost the full range of high Andean waterfowl occur in the various wetland habitats present. The commoner breeding species include *Podiceps occipitalis, Phalacrocorax olivaceus, Nycticorax nycticorax, Plegadis ridgwayi, Chloephaga melanoptera* (abundant), *Lophonetta specularioides, Anas flavirostris, A. georgica, Fulica americana, F. gigantea* (abundant), *Vanellus resplendens, Charadrius alticola, Eudromias ruficollis*, three species of Thinocoridae, and *Larus serranus*. Other interesting breeding species include *Theristicus (c) branickii, Merganetta armata, Phegornis mitchellii* and *Recurvirostra andina*. Five species of Nearctic shorebird are common visitors, *Pluvialis dominica, Tringa melanoleuca, T. flavipes, Calidris bairdii* and *C. melanotos*.
Other fauna: The Vicuna *Vicugna vicugna* and *Hippocamelus antisensis* occur in the area.
Threats: Alterations in the drainage systems, and future drainage schemes pose threats at some lakes; the bofedales of Ulla-Ulla are polluted by domestic sewage from the village; overgrazing by domestic livestock is a problem throughout the area; and there is some illegal hunting.
Research and conservation: A considerable amount of research has been conducted in the Reserve in recent years, particularly on the Vicuna and waterfowl.
References: Cabot & Serrano (1982 & in press); Ribera & Hanagarth (1982); Serrano & Cabot (1982); IUCN (1982); Cabot (in press); Serrano (in press).
Source: Marco O. Ribera.
Criteria for inclusion: 123.

Rio Charazani (3)

Location: 15°10'S, 68°50'W; 160 km NNW of La Paz, La Paz Department.
Area: Unknown.
Altitude: 3,200-4,000m.
Province and type: 8.36.12; 10.
Site description: A fast-flowing relatively clear mountain river on the humid east slope of the Andes, rising in the Ulla-Ulla National Reserve. Water levels reach their highest during the wet summer months.
Principal vegetation: Mainly herbaceous and shrubby vegetation along the river banks, with some patches of dense riverine forest at lower elevations.
Land tenure: State owned.

Protection: None.
Land use: Trout farming and fishing.
Waterfowl: An important river for the Torrent Duck *Merganetta armata* which, because of its dependence on clear mountain rivers and streams, has disappeared from the many turbid and polluted rivers in the region.
Other fauna: Passerines characteristic of fast-flowing rivers including *Cinclodes fuscus, C. atacamensis* and *Cinclus leucocephalus.*
Threats: Deforestation and overgrazing in the watershed resulting in soil erosion and increasing turbidity of rivers and streams is now threatening this drainage system. There is also some pollution from nearby mines, and uncontrolled hunting and fishing.
Research and conservation: The need for better management of watersheds throughout the region is apparent.
Source: Marco O. Ribera.
Criteria for inclusion: 2b & 3a.

Wetlands in the Tuni Condoriri National Park (4)

Location: 16°10'S, 68°15'W; 45 km NNW of La Paz, La Paz Department.
Area: Several hundred ha.
Altitude: 4,000-4,300m.
Province and type: 8.36.12; 10, 12, 17 & 19.
Site description: A group of small glacial lakes including Hichukhota and Khara Khota, fast-flowing mountain streams, and bofedales in the high Andes. Hichukhota (60-80 cm deep) is the only lake with aquatic vegetation. Water levels fluctuate seasonally, and the lakes freeze around their edges in winter. Some of the lakes have been modified by dams.
Principal vegetation: In the puna zone, with *Stipa, Festuca* and *Werneria* spp.
Land tenure: State owned.
Protection: Within the Tuni Condoriri National Park (14,828 ha) established in 1942.
Land use: Grazing of domestic livestock; recreation including winter sports. Some of the lakes are used for domestic water supply to La Paz, and there are tin mines in the area.
Waterfowl: A variety of breeding waterfowl including *Chloephaga melanoptera, Lophonetta specularioides, Anas puna* and *Fulica gigantea.* Several species of Nearctic shorebirds occur on migration.
Other fauna: No information.
Threats: There is a potential threat of pollution from nearby mines; and hunting is uncontrolled.
Research and conservation: Better enforcement of the Park regulations is called for.
References: Jungius & Pujol (1970); IUCN (1982); Montes (1982).
Source: Percy Baptista and Eliana Flores.
Criteria for inclusion: 3a.

Rio Desaguadero (5)

Location: 17°28'S, 68°30'W; between Lake Titicaca and Lake Uru-Uru, La Paz and Oruro Departments.
Area: 370 km of river.
Altitude: 3,775m.
Province and type: 8.36.12; 10 & 11.
Site description: A large relatively fast-flowing river with muddy banks and some riverine marshes; the only river flowing out of Lake Titicaca. Formerly the river flowed into Lake Poopo, but in recent years it has changed its course and now flows into Lake Uru-Uru. There is relatively little fluctuation in water level, and the shores freeze at night.
Principal vegetation: *Parastrephia* sp is dominant along the river banks. In the puna zone, with grassland of *Festuca* sp and *Stipa* sp, and cultivated *Chenopodium quinoa.*
Land tenure: State owned.
Protection: None.

Land use: Livestock grazing; agriculture; hunting and fishing.
Waterfowl: A variety of puna waterfowl including the local Short-winged Grebe *Rollandia micropterum, Phoenicopterus chilensis, Phoenicoparrus andinus* and *Recurvirostra andina.*
Other fauna: Several native species of fishes and the introduced *Basilichthys bonariensis* (introduced in the 1950s).
Threats: Excessive hunting.
References: Carmouze *et al* (1977b).
Source: Eliana Flores.
Criteria for inclusion: 3a.

Lake Uru-Uru (6)

Location: 18°05'S, 67°06'W; south of Oruro, Oruro Department.
Area: 28,000 ha.
Altitude: 3,693m.
Province and type: 8.36.12; 14.
Site description: A large permanent shallow brackish lake in the high Andean puna zone, fed by the Rio Desaguadero, and with extensive emergent aquatic vegetation. There are wide fluctuations in water level, and at low levels, extensive areas of mud are exposed. The salinity varies from almost fresh to up to 16 p.p.t., and the waters are generally turbid. The lake dried out almost completely during the severe drought of 1983, but was flooded again by heavy rains in early 1984.
Principal vegetation: Extensive beds of emergent *Schoenoplectus tatora*; the lake is surrounded by heavily grazed puna grassland with species of *Stipa, Festuca* and *Werneria.*
Land tenure: State owned.
Protection: None.
Land use: Subsistence fishing and some subsistence hunting. An indigenous ethnic group, the Urus, live on islands built of reeds.
Waterfowl: A very important lake for breeding waterfowl, particularly Anatidae and *Fulica americana*, non-breeding flamingos, and Nearctic shorebirds. The commoner breeding species include *Rollandia rolland, Phalacrocorax olivaceus, Nycticorax nycticorax, Plegadis ridgwayi, Anas puna, A. cyanoptera, Oxyura jamaicensis ferruginea, Fulica americana, Himantopus himantopus, Recurvirostra andina* and *Larus serranus. Rollandia micropterum* was a common breeding bird, but apparently disappeared during the drought in 1983. The population of avocets is particularly important; up to 200 have been recorded, an unusually large concentration for this rather scarce and local species. Tens of thousands of flamingos occur as non-breeding visitors, including all three Andean species; 40,000 were present after recent flooding in 1984. *Phoenicopterus chilensis* appears to be the commonest, and up to 11,000 have been identified at one time, but 18,000 *Phoenicoparrus andinus* were recorded in December 1972, and up to 3,000 *P. jamesi* have been observed. Very large numbers of Nearctic shorebirds "winter" around the lake; in February 1981, there were thousands of *Tringa melanoleuca* and *T. flavipes*, and hundreds of *Calidris bairdii, C. melanotos* and *Micropalama himantopus* in one small bay at the north end of the lake. *Steganopus tricolor* is common at times, and *Limosa haemastica* has been recorded.
Other fauna: Fishes include the native *Pygidium barbouri* and the introduced *Basilichthys bonariensis.*
Threats: There is some pollution from domestic sewage from the town of Oruro to the north of the lake, but otherwise the lake does not appear to be under any serious threat at the moment.
References: Kahl (1975); Pearson (1975a); Hurlbert (1978 & 1981).
Source: Eliana Flores, Robert S. Ridgely and Derek A. Scott.
Criteria for inclusion: 123.

Lake Poopo (7)

Location: 18°50'S, 67°00'W; 60 km south of Oruro, Oruro Department.
Area: 133,700 ha.
Altitude: 3,685m.
Province and type: 8.36.12; 14.
Site description: A very large shallow saline lake, up to 3m deep, with turbid waters and extensive areas of exposed mud. The water level fluctuates seasonally, but the lake is in the process of drying out. The salinity is not uniform; it is highest (up to 26 p.p.t.) in the southwest, and lowest at the mouth of the river bringing fresh to brackish water from Lake Uru-Uru.
Principal vegetation: Beds of *Schoenoplectus tatora, Chara poopoensis* and *Ruppia* sp.
Land tenure: State owned.
Protection: None.
Land use: Subsistence fishing and hunting.
Waterfowl: Presumably similar to Lake Uru-Uru. The Short-winged Grebe *Rollandia micropterum* is common, and the lake is particularly important for flamingos. 100,000 *Phoenicopterus chilensis* were present in January 1972, and 75,000 in February 1973. Up to 2,060 *Phoenicoparrus andinus* and 8,000 *P. jamesi* have been recorded, and *P. jamesi* is reported to have nested at the south end of the lake in the 1960s.
Other fauna: The native fish *Pygidium barbouri* and the introduced *Basilichthys bonariensis*.
Threats: A shift in the course of the Rio Desaguadero and the severe drought of 1983 have resulted in a significant drop in the lake level. There is some hunting of flamingos for food.
Research and conservation: Some limnological studies and floral surveys have been conducted, but the avifauna remains poorly known, and detailed surveys are clearly called for.
References: Allen (1921); Carmouze *et al* (1977b); Vargas (?); Kahl (1975); Hurlbert (1978); Hurlbert & Keith (1979); Collot (1982).
Source: Eliana Flores.
Criteria for inclusion: 123.

Laguna Corani (8)

Location: 17°05'S, 65°50'W; 50 km northeast of Cochabamba, Cochabamba Department.
Area: Several hundred ha.
Altitude: 3,200m.
Province and type: 8.35.12; 15.
Site description: A freshwater hydroelectric dam with clear waters, steep shores, wide fluctuations in water level, and little aquatic vegetation.
Principal vegetation: In a montane grassland zone.
Land tenure: State owned.
Protection: No information.
Land use: Production of electricity; sport fishing.
Waterfowl: In January 1984, there were 1,000 *Phalacrocorax olivaceus*, 300 *Anas flavirostris* and 500 *Oxyura jamaicensis ferruginea* on the dam. Presumably an important area for wintering waterfowl, but unsuitable for breeding because of the wide fluctuations in water levels.
Other fauna: No information.
Threats: None known.
Source: Eliana Flores and Jon Fjeldsa.
Criteria for inclusion: 0.

Laguna Alalay (9)

Location: 17°25'S, 66°07'W; at Cochabamba, Cochabamba Department.
Area: 50 ha.
Altitude: 2,558m.

Province and type: 8.35.12; 12.
Site description: A shallow freshwater lake with turbid waters, and surrounding muddy areas and wet grassland; on the outskirts of Cochabamba city. The water level fluctuates seasonally.
Principal vegetation: In a semi-arid Andean valley, with heavily overgrazed grassland around the lake.
Land tenure: State owned.
Protection: None.
Land use: Grazing of domestic livestock around the lake.
Waterfowl: A very wide variety of waterfowl of both high Andean and lowland species have been recorded, mainly as non-breeding visitors. Breeding species include *Rollandia rolland*, *Podiceps occipitalis* (up to 400 birds present), *Charadrius collaris* and *Himantopus himantopus* (up to 120). Common non-breeding visitors include *Plegadis ridgwayi* (up to 105), *Anas puna* (up to 200), *Oxyura jamaicensis ferruginea* (up to 2,550), *Fulica americana* (up to 800), and *Larus serranus* (up to 250). Seven species of Nearctic shorebirds have been recorded, including up to 180 *Calidris melanotos* and up to 10,000 *Steganopus tricolor*. Unusual lowland species which have been observed include *Dendrocygna autumnalis*, *Sarkidiornis melanotos* and *Rynchops niger*.
Other fauna: No information.
Threats: The lake is polluted with domestic sewage from Cochabamba city, and there is a considerable amount of human disturbance.
Research and conservation: Detailed avifaunal surveys were conducted by Dott between 1969 and 1974. The lake has considerable potential for conservation education and recreation.
References: Dott (in press).
Source: Jose Cabot and H. E. M. Dott.
Criteria for inclusion: 2b & 3a.

Rio Sajama, Rio Tomaravi (Taramani) and Rio Lauca (10)

Location: 18°00'-18°35'S, 68°45'-69°05'W; south of Sajama, Oruro Department.
Area: Unknown.
Altitude: 3,900-4,000m.
Province and type: 8.36.12; 10, 14 & 19.
Site description: Three fast-flowing high Andean rivers and their tributary streams; extensive areas of Andean bogs (bofedales); and some salt flats. The Rio Sajama rises on the Cerro de Sajama; Rio Tomaravi rises in Lake Huana Khota; and Rio Lauca rises in the Lauca National Park in northern Chile. During the severe drought of 1983, the rivers fell to unusually low levels, but the heavy rains of 1984 have restored normal flow.
Principal vegetation: Bofedales with *Oxychloe andina*, *Calamagrostis ouata* and *C. jamesii*; salt flats with *Salicornia* sp; and marshy areas with *Festuca* and *Parastrephia* spp. In the puna grassland zone.
Land tenure: State owned.
Protection: None; the Rio Sajama is fed by waters from snow melt in the Cerro de Sajama National Park (29,940 ha) established in 1945.
Land use: Livestock grazing on the bofedales.
Waterfowl: The area is rich in the typical high Andean waterfowl, including *Plegadis ridgwayi* and *Chloephaga melanoptera*.
Other fauna: The rare Puna Rhea *Pterocnemia pennata tarapacensis* occurs in the area.
Threats: The Rio Lauca has been diverted for irrigation near its source in Chile, and there has been a considerable reduction in the flow of this river into Bolivia. This is contributing to the dessication of the Salar de Coipasa.
Research and conservation: Some studies have been carried out on the plant communities of the region by the Instituto de Ecologia, UMSA.
Source: Eliana Flores.
Criteria for inclusion: 2a & 3a.

Salar de Coipasa (11)

Location: 19°15'S, 68°10'W; 180 km southwest of Oruro, Oruro Department.
Area: 221,800 ha.
Altitude: 3,692m.
Province and type: 8.36.12; 14.
Site description: A vast salar (salt basin) and shallow hypersaline lake; a relict of a large Pleistocene lake (Minchin). The lake receives water from the Rio Lauca, and a number of smaller rivers and streams. The lake is in the process of drying out. The salts include NaCl, and carbonates of sodium and borium.
Principal vegetation: *Salicornia* sp in some areas.
Land tenure: State owned.
Protection: None.
Land use: Grazing of domestic livestock in surrounding areas by the Chipaya Indians.
Waterfowl: A wide variety of high Andean species have been recorded, including all three species of Phoenicopteridae, *Charadrius alticola, Phegornis mitchellii, Recurvirostra andina*, three species of Thinocoridae, and six species of Nearctic shorebirds, but no census data are available.
Other fauna: The Puna Rhea *Pterocnemia pennata tarapacensis* and Vicuna *Vicugna vicugna* occur in the area.
Threats: A project proposal exists for the exploitation of lithium, potassium and borium from the salar, and reduced flow in the Rio Lauca is contributing to the dessication of the salar (see site 10).
Research and conservation: There is an urgent need for detailed faunal and floral investigations of this important salar.
Source: Eliana Flores.
Criteria for inclusion: 2a & 3a.

Salar de Uyuni (12)

Location: 20°10'S, 67°30'W; west of Uyuni, Potosi Department.
Area: 1,058,200 ha.
Altitude: 3,665m.
Province and type: 8.36.12; 14 & 19.
Site description: A vast salar with very deep salt deposits; a salt crust averaging 22 cm thick covers a bed of rock salt. The lake is a relict of a large Pleistocene lake (Minchin), and is fed by the Rio Grande de Lipez. There are many small hypersaline lakes around the perimeter of the salar, and adjacent freshwater Andean bogs (bofedales).
Principal vegetation: The salar itself has very little vegetation, but there are some areas of *Salicornia* sp. The bofedales are dominated by *Oxychloe andina* and species of *Calamagrostis* and *Festuca.*
Land tenure: State owned, but concessions have been made to private companies for the exploitation of salt.
Protection: None.
Land use: Exploitation of salt (NaCl).
Waterfowl: A wide variety of high Andean waterfowl occur around the small areas of open water and on the bofedales, but the area is primarily important for flamingos. 3,000-4,000 *Phoenicopterus chilensis* were found breeding in 1973, and *Phoenicoparrus jamesi* is reported to have nested along the northeast shore.
Other fauna: No information.
Threats: A project proposal exists for the exploitation of lithium, potassium and borium.
References: Kahl (1975); Hurlbert & Keith (1979).
Source: Eliana Flores.
Criteria for inclusion: 1b & 3a.

Lagunas de Pastos Grandes (13)

Location: 21°30'-21°56'S, 67°35'-68°05'W; 160 km southwest of Uyuni, Potosi Department.
Area: 15,000 ha.
Altitude: 4,100-4,510m.
Province and type: 8.36.12; 14 & 19.
Site description: A group of nine small permanent saline lakes in the altiplano, with surrounding salt flats and bofedales. The lakes are fed by underground sources, and the waters have a high sulphur content. The lakes are: Salar de Pastos Grandes (12,500 ha, 4.432m); Laguna Ramaditas (100 ha, 4,117m); Laguna Hedionda (300 ha, 4,121m); Laguna Cañapa (40 ha, 4,140m); Laguna Cachi (140 ha, 4,490m); Laguna Khara (1,200 ha, 4,509m); Laguna Chulluncani (80 ha, 4,450m); and Laguna Khar Khota (200 ha, 4,112m).
Principal vegetation: In the puna zone with semi-desertic steppe and dwarf scrub.
Land tenure: State owned.
Protection: None.
Land use: A very remote area with little human habitation; some grazing of llamas and alpacas around Laguna Canapa.
Waterfowl: A variety of high Andean waterfowl occur, and the area is particularly important for flamingos. All three Andean species have been recorded at all nine lakes, but the largest concentrations occur on Salar de Pastos Grandes (up to 2,250), Laguna Hedionda (up to 4,600), L. Cachi (up to 2,870), L. Khara (up to 990) and L. Chulluncani (up to 1,300). The bulk of the birds are *Phoenicopterus chilensis* and *Phoenicoparrus jamesi*, and over 4,000 of each have been observed at L. Hedionda. *P. andinus* is much less common, with peak counts of 650 at L. Cachi, 455 at Salar de Pastos Grandes, and 400 at L. Hedionda. Flamingos breed in the area, but the species involved is unknown.
Other fauna: The Puna Rhea *Pterocnemia pennata tarapacensis* and Vicuna *Vicugna vicugna* occur in the area.
Threats: Hunting and collection of flamingo eggs for human consumption.
References: Hurlbert (1978 & 1981); Hurlbert & Chang (1984).
Source: Eliana Flores.
Criteria for inclusion: 1b.

Wetlands in Eduardo Avaroa National Faunal Reserve (14)

Location: 22°00'-22°53'S, 66°56'-68°02'W; 240 km SSW of Uyuni, Potosi Department.
Area: 23,450 ha of wetlands including Salar de Chalviri.
Altitude: 4,250-5,780m.
Province and type: 8.36.12; 10, 12, 14 & 19.
Site description: A large number of small, mainly saline, lakes; the Salar de Chalviri; a number of fast-flowing acidic rivers and streams; and surrounding springs and bofedales. The principal lakes are Laguna Colorada (5,240 ha), L. Verde (2,110 ha), L. Kalina (1,600 ha), L. Catalcito (250 ha), L. Guayaques (130 ha), L. Loromayu (900 ha) and L. Honda (50 ha). L. Colorada and the Salar de Chalviri (11,500 ha) are described separately below. All the lakes except Laguna Totoral are saline, and several have permanent ice islands. L. Totoral is a small shallow freshwater lake with surrounding bofedales. The principal rivers are Rio Quetena and Rio Silala.
Principal vegetation: Extensive bofedales with *Oxychloe andina* and *Calamagrostis* spp; and dry puna steppe with dwarf shrubs of *Parastrephia* sp. In the temperate subalpine desert and dry alpine temperate tundra zones.
Land tenure: State owned.
Protection: Within the Eduardo Avaroa National Faunal Reserve, established in 1973 (400,000 ha) and increased in size to 714,745 ha in 1981.
Land use: There are several small settlements in the reserve, dependent on the rearing of llamas and alpacas, a little cultivation, and illegal hunting. The waters of the Rio Quetena supply Quetena Chico village, and there is a sulphur mine and military border post near Laguna Verde. Flamingo eggs are collected for human consumption.

Waterfowl: A very rich area for high Andean waterfowl, particularly flamingos and the rare *Fulica cornuta.* The main concentrations of flamingos occur at L. Colorada and Salar de Chalviri (see below), and at L. Kalina (up to 12,900), L. Guayaques (up to 8,000) and L. Loromayu (up to 4,000). Although the region is best known for its large breeding colony of *Phoenicoparrus jamesi* at L. Colorada, all three Andean species are common. *Phoenicopterus chilensis* has bred at Loromayu (up to 2,000 birds) and occurs in large numbers at Kalina (up to 3,300); *P. andinus* occurs in large numbers as a non-breeding visitor, chiefly at Chalviri (up to 5,200), Kalina (up to 1,675) and Verde (up to 585); and *P. jamesi* has occurred in large numbers on Guayaques (up to 8,000) and Kalina (up to 4,200). The Horned Coot *F. cornuta* may be commoner here than anywhere else in its range. Small numbers have been recorded on L. Catalcito and L. Totoral, but a concentration of 2,800 has been observed on Laguna Pelada, one of the smaller lakes in the Reserve. Other interesting species in the Reserve include *Recurvirostra andina, Attagis gayi, Calidris bairdii* and *Steganopus tricolor.* Up to 670 *C. bairdii* have been observed on a single lake.

Other fauna: The Puna Rhea *Pterocnemia pennata tarapacensis* and Vicuna *Vicugna vicugna* occur in the Reserve.

Threats: The collection of flamingo eggs for human consumption continues to disturb the breeding colonies, and there are some problems with illegal hunting in the Reserve. There is some pollution in Laguna Verde from effluents from the nearby sulphur mine.

Research and conservation: A variety of faunal and floral studies have been conducted in the Reserve, and the breeding colony of *P. jamesi* at Laguna Colorada has received a considerable amount of attention. Limnological studies have been conducted at Salar de Chalviri by Hurlbert and Chang. The Laguna Verde area is of special palaeontological and archeological interest.

References: Jungius & Pujol (1970); Morrison (1975); Hurlbert (1978 & 1981); INFOL (1980); Alzerreca (1982); IUCN (1982); Hurlbert & Chang (1983 & 1984).

Source: Eliana Flores.

Criteria for inclusion: 123.

Laguna Colorada (14a)

Location: 22°10'S, 67°45'W; 210 km SSW of Uyuni, Potosi Department.

Area: 5,240 ha.

Altitude: 4,300m.

Province and type: 8.36.12; 14 & 19.

Site description: A hypersaline lake of glacial origin receiving its water from a number of small streams and thermal springs; and surrounding bofedales. The salinity of the lake varies from 50 to 250 p.p.t., there are 100 ha of "ancient" ice islands, and the shores freeze at night. The water has a bright orange colour due to the presence of a dense population of the flagellate *Dunaliella salina.*

Principal vegetation: Bofedales with *Oxychloe andina* and species of *Calamagrostis* and *Festuca.*

Land tenure: State owned.

Protection: Within the Eduardo Avaroa National Faunal Reserve.

Land use: Livestock grazing (llamas and alpacas); and some tourism.

Waterfowl: The main breeding area hitherto known of the James' Flamingo *Phoenicoparrus jamesi.* Up to 26,000 individuals have been observed during the breeding season. Much smaller numbers of *P. andinus* (up to 1,000) and *Phoenicopterus chilensis* (up to 4,000) have been recorded, and both have nested. Other waterfowl include up to 250 *Charadrius alticola* and up to 107 *Recurvirostra andina.*

For other information, see (14).

Salar de Chalviri (14b)

Location: 22°30'S, 67°33'W; 240 km SSW of Uyuni, Potosi Department.
Area: 11,500 ha.
Altitude: 4,388m.
Province and type: 8.36.12; 14 & 19.
Site description: An old salt lake (salar) in the process of drying out, with about a dozen saline lakes around its perimeter, separated from one another by salt flats, and fed by small streams and thermal springs. There are wet grassy areas at the northwest corner of the lake, and bofedales near the southeast shore. The salinity of the lakes varies from 8 to 100 p.p.t., there are some "ancient" ice islands, and the shores freeze at night.
Principal vegetation: Wet grassy areas with *Festuca* and *Anthobrium* spp; bofedales with *Oxychloe andina* etc.
Land tenure: State owned.
Protection: Within the Eduardo Avaroa National Faunal Reserve.
Land use: Some tourism, and illegal hunting of Vicunas.
Waterfowl: An important salar for all three Andean flamingos. Up to 1,700 *Phoenicopterus chilensis*, 5,240 *Phoenicoparrus andinus*, and 3,760 *P. jamesi* have been recorded; *P. chilensis* has bred in large numbers, and 25 pairs of *P. jamesi* attempted to breed in 1975. *Recurvirostra andina* also occurs.
For other information, see (14).

Lagunas de San Ildefonso (15)

Location: 19°40'S, 65°40'W; ESE of Potosi, Potosi Department.
Area: c.2,000 ha.
Altitude: 4,000-4,500m.
Province and type: 8.35.12; 12.
Site description: A group of over fifteen permanent shallow freshwater glacial lakes in the high Andes near Potosi. The lakes dried out for the first time in recorded history during the severe drought of 1983.
Principal vegetation: No information.
Land tenure: State owned.
Protection: None.
Land use: The water is used for human consumption in Potosi.
Waterfowl: No information.
Other fauna: No information.
Threats: None known.
References: Montes (1982).
Source: Eliana Flores.
Criteria for inclusion: 0.

Rio Pilcomayo (16)

Location: 21°15'S, 63°30'W; Villa Montes, Tarija Department.
Area: Area of wetlands unknown; river basin 9,810,000 ha.
Altitude: 265-5,200m.
Province and type: 8.21.4/8.35.12; 09, 10 & 16.
Site description: A fast-flowing river rising in the eastern Andes and crossing the dry chaco woodland of southeastern Bolivia. The river floods in the summer months, inundating adjacent areas of grassland.
Principal vegetation: Dry evergreen woodland with *Aspidosperma quebracho* in the lower reaches.
Land tenure: State owned.
Protection: None.

Land use: Fishing; some agriculture in the upper reaches and some forest exploitation in the lower reaches.
Waterfowl: Similar to Rio Bermejo (site 17).
Other fauna: The fish fauna includes *Prohilodus nigricans*, *Mylossoma duriventre* and *Surubim lima.*
Threats: Uncontrolled hunting, fishing and exploitation of wildlife for the animal trade.
References: Terrazas (1970); Alaharce & Lucero (1977); Montes (1982).
Source: Eliana Flores.
Criteria for inclusion: 0.

Rio Bermejo (17)

Location: 22°45'S, 64°18'W; SSE of Tarija, Tarija Department.
Area: Area of wetlands unknown; river basin 1,231,000 ha.
Altitude: 420-1,000m.
Province and type: 8.21.4; 10 & 16.
Site description: A fast-flowing river, rising in the eastern Andes, flowing through dry chaco woodland and, during the summer floods, inundating extensive areas of grassland and arable land.
Principal vegetation: Dry chaco woodland along the lower course of the river.
Land tenure: State owned.
Protection: None.
Land use: Livestock grazing; agriculture, particularly sugar cane production; and wood-cutting.
Waterfowl: A variety of waterfowl characteristic of the chaco occur, including *Syrigma sibilatrix, Ixobrychus involucris, Neochen jubata, Anas versicolor, A. leucophrys, Porphyriops melanops* and *Larus cirrocephalus.* The Horned Screamer *Anhima cornuta* has also been recorded.
Other fauna: No information.
Threats: Overgrazing and soil erosion in the watershed.
References: Montes (1982).
Source: Eliana Flores.
Criteria for inclusion: 0.

Bañados del Izozog and Rio Parapeti (18)

Location: 17°50'S, 61°20'W to 19°30'S, 62°30'W; 140 km southeast of Santa Cruz, Santa Cruz Department.
Area: 500,000 ha.
Altitude: 300m.
Province and type: 8.21.4; 9 & 12.
Site description: A large area of seasonal shallow freshwater lakes and marshes comprising the inland delta of the Rio Parapeti, which flows for only three months of the year, in the austral summer. In the dry season, the water table drops to 15m below ground level, the river and marshes dry out almost completely, and some saline flats are exposed.
Principal vegetation: In a region of dry deciduous chaco woodland.
Land tenure: State owned.
Protection: None.
Land use: Cattle ranching; wood-cutting for charcoal production.
Waterfowl: No information, but the avifauna is presumably similar to that of other wetland areas in the chaco.
Other fauna: The Spectacled Caiman *Caiman crocodilus yacare* is known to occur.
Threats: There is a considerable amount of hunting for the animal trade; and the forests are rapidly being destroyed.
References: Montes (1982).
Source: Eliana Flores.
Criteria for inclusion: 0.

Bañados de Otuquis (19)

Location: 19°55'S, 58°05'W; 350 km southeast of San Jose de Chiquitos, Santa Cruz Department.
Area: 185,000 ha.
Altitude: 140m.
Province and type: 8.30.10; 09 & 12.
Site description: Seasonal shallow freshwater lakes and marshes on the flood plain of a small tributary of the Rio Paraguay, near its confluence with that river; at the western edge of the Pantanal Matogrossense.
Principal vegetation: In a region of dry chaco woodland.
Land tenure: State owned.
Protection: None.
Land use: Hunting for the animal trade, and boat traffic on the nearby Rio Paraguay. There are iron ore deposits in the region but these have not as yet been exploited.
Waterfowl: No information, but presumably similar to other chaco wetlands.
Other fauna: The Giant River Otter *Pteronura brasiliensis* and Spectacled Caiman *Caiman crocodilus yacare* are known to occur.
Threats: Excessive exploitation of wildlife for the animal trade.
References: Montes (1982).
Source: Eliana Flores.
Criteria for inclusion: 2a.

Bañados de Petas and Bañados de San Matias (20)

Location: 16°18'-17°20'S, 58°20'-60°00'W; 200 km northwest of San Jose de Chiquitos, Santa Cruz Department.
Area: 1,000,000 ha.
Altitude: 130m.
Province and type: 8.30.10; 09, 11, 13 & 16.
Site description: A slow-flowing river with extensive riverine marshes, and a vast area of seasonal freshwater marshes, seasonally flooded palm savanna and seasonally flooded forest; the western portion of the Pantanal Matogrossense, the greater part of which lies in Brazil (see Brazil site 23).
Principal vegetation: Beni savanna.
Land tenure: State owned.
Protection: None.
Land use: No information.
Waterfowl: No information.
Other fauna: *Caiman crocodilus yacare* is known to occur.
Threats: No information.
Source: Eliana Flores.
Criteria for inclusion: 0.

Bañados de San Ignacio (21)

Location: 16°20'S, 61°00'W; 160 km north of San Jose de Chiquitos, Santa Cruz Department.
Area: 200,000 ha.
Altitude: 405m.
Province and type: 8.30.10; 09, 11, 13, 16 & 18.
Site description: Slow-flowing rivers and streams with riverine marshes and riverine forest; and large areas of seasonal freshwater marshes, and seasonally flooded forest and palm savanna; at the headwaters of the Rio Paragua and Rio Paraiso.
Principal vegetation: Beni savanna.
Land tenure: State owned.
Protection: None.
Land use: Cattle ranching.

Waterfowl: No information.
Other fauna: *Caiman crocodilus yacare* is known to occur.
Threats: No information.
Source: Eliana Flores.
Criteeria for inclusion: 0.

Bañado San Diego and Bañado El Marfil (22)

Location: 15°30'-16°20'S, 60°15'W; 200 km NNE of San Jose de Chiquitos, Santa Cruz Department.
Area: 150,000 ha.
Altitude: 180m.
Province and type: 8.30.10; 09, 11, 12 & 16.
Site description: Riverine marshes, seasonal shallow freshwater lakes and marshes, and large areas of seasonally flooded savanna along the upper Rio Paragua on the Brazilian border.
Principal vegetation: Humid Beni savanna.
Land tenure: State owned.
Protection: None.
Land use: No information.
Waterfowl: No information.
Other fauna: No information.
Threats: No information.
Source: Eliana Flores.
Criteria for inclusion: 0.

Rio Itenez (Guapore) (23)

Location: 13°31'S, 60°25'-61°50'W; between Puerto Villazon and Catamarca, Santa Cruz Department.
Area: Over 200 km of river.
Altitude: 225m.
Province and type: 8.30.10/8.6.1; 09, 11, 16 & 18.
Site description: A large deep meandering river with riverine marshes, seasonally flooded gallery forest, and extensive areas of seasonally flooded palm savanna, along the Brazilian border.
Principal vegetation: Humid savanna with scattered palms and "islands" of forest.
Land tenure: State owned.
Protection: None.
Land use: There is very little human activity on the Bolivian side of the river, but some agriculture on the Brazilian side.
Waterfowl: No information.
Other fauna: No information.
Threats: None known.
Source: Eliana Flores.
Criteria for inclusion: 0.

Rio Baures and Rio Zapecos (24)

Location: 12°30'-16°20'S, 63°30'W; Bella Vista, Beni Department.
Area: 500 km of river.
Altitude: 180-500m.
Province and type: 8.6.1/8.30.10; 09, 11, 12, 16 & 18.

Site description: Large deep slow-flowing turbid rivers with riverine marshes, gallery forest and swamp forest; numerous permanent and seasonal freshwater lakes and marshes; and extensive areas of seasonally flooded savanna in the basin of the Rio Baures and its tributaries.
Principal vegetation: Gallery forest with species of *Cecropia, Ocroma* and *Inga*; humid savannas with species of *Paspalum, Cisaquirium* and *Panicum*; lakes and marshes with species of *Rinchelitrium* and *Killingea.*
Land tenure: State owned.
Protection: None.
Land use: Cattle ranching, hunting, fishing and wood-cutting.
Waterfowl: A wide variety of waterfowl typical of riverine marshes and flood plains was observed during a brief survey in November 1983, including *Phalacrocorax olivaceus, Anhinga anhinga, Tigrisoma lineatum, Pilherodius pileatus, Cochlearius cochlearius, Ardea cocoi, Mycteria americana, Jabiru mycteria, Theristicus caudatus, Mesembrinibis cayennensis, Ajaia ajaja, Dendrocygna viduata, Sarkidiornis melanotos, Opisthocomus hoazin, Aramides cajanea, Heliornis fulica, Eurypyga helias* and *Jacana jacana.*
Other fauna: The Giant River Otter *Pteronura brasiliensis*, Spectacled Caiman *Caiman crocodilus yacare* and freshwater turtles *Podocnemis* spp occur. Fishes include *Serrasalmus spilopleura, Colossoma brachipomum* and *Metynnis roosevelti.*
Threats: Uncontrolled hunting and fishing, and particularly the capturing of wildlife for the animal trade.
Source: Eliana Flores and Raul Lara.
Criteria for inclusion: 2a.

Rio Itonamas and Rio San Pablo (25)

Location: 12°35'-15°42'S, 63°10'-64°20'W; Magdalena and San Pablo, Beni and Santa Cruz Departments.
Area: Over 400 km of river.
Altitude: 230-500m.
Province and type: 8.6.1; 09, 11, 12, 16 & 18.
Site description: A complex of slow-flowing rivers with associated riverine marshes, gallery forest and swamp forest; numerous permanent and seasonal freshwater lakes and marshes; and large areas of seasonally inundated palm savanna. The region includes the San Luis, Cueva, San Alberto, San Ramon and Concepcion lake systems.
Principal vegetation: Dense riverine thickets with species of *Cecropia, Ochroma* and *Salix*; humid tropical forest along the rivers; and palm savanna.
Land tenure: State owned.
Protection: None.
Land use: Cattle ranching and exploitation of timber.
Waterfowl: No information is available specifically for this area, but the region is known to be very rich in waterfowl, and most if not all of the species listed by West for the lowlands of eastern Bolivia might be expected to occur.
Other fauna: Apparently similar to the Rio Baures (site 24).
Threats: Uncontrolled hunting and fishing, and particularly the capture of wildlife for the animal trade.
References: West (1979).
Source: Eliana Flores.
Criteria for inclusion: 0.

Rio Mamore (26)

Location: 13°00'-16°00'S, 64°25'-65°00'W; Trinidad, Beni Department.
Area: 400 km of river.
Altitude: 140-155m.
Province and type: 8.6.1; 09, 11, 12, 16 & 18.

Site description: The Rio Mamore and its flood plain from the confluence of the Rio Ichilo and Rio Grande to Puerto Abaroa. A large meandering turbid river, up to 12m deep, with associated oxbow lakes and riverine marshes, gallery forest and swamp forest; many permanent and seasonal freshwater lakes and marshes; and extensive areas of seasonally inundated grassland and palm savanna. The rainy season is from November to February.
Principal vegetation: In a region of Beni savanna with some humid tropical forest.
Land tenure: State owned.
Protection: The river and its flood plain are unprotected, but nearby permanent lakes are included within the Lagunas de Beni y Pando National Reserve (see site 30).
Land use: Navigation along the Mamore between Puerto Villaroel and Guayaramerin; hunting and fishing.
Waterfowl: An extremely important area for waterfowl, with most if not all of the species typical of the eastern lowlands of Bolivia occurring. Some of the commoner species include *Anhinga anhinga, Ardea cocoi, Mycteria americana, Euxenura maguari, Jabiru mycteria, Mesembrinibis cayennensis, Chauna torquata, Dendrocygna viduata, Cairina moschata, Opisthocomus hoazin, Aramus guarauna, Porphyrula flavirostris, Jacana jacana, Hoploxypterus cayanus, Charadrius collaris, Phaetusa simplex* and *Sterna superciliaris.*
Other fauna: The area is rich in birds of prey, and *Cathartes burrovianus, Rostrhamus hamatus, Circus buffoni* and *Busarellus nigricollis* are common. The Giant River Otter *Pteronura brasiliensis*, the dolphin *Inia geoffrensis* and the Spectacled Caiman *Caiman crocodilus yacare* occur. Fishes include *Salminus maxillosus, Myleus setiger* and *Cichla ocellaris.*
Threats: Uncontrolled hunting and fishing.
Research and conservation: There is a great need for a more integrated approach to conservation of wildlife resources in the region. The riverine systems such as that of the Mamore should be considered along with the Beni and Pando lakes in an overall conservation plan for the area.
References: Macias & Sejas (1974); Monje (1977); Montes (1982).
Source: Eliana Flores and Derek A. Scott.
Criteria for inclusion: 123.

Wetlands in the Isiboro-Secure National Park (27)

Location: 15°33'-16°48'S, 65°09'-66°55'W; Chipiriri and Puerto Totora, Cochabamba Department.
Area: Area of wetlands unknown; the basin of the Rio Isiboro is 952,700 ha and that of the Rio Secure 46,670 ha.
Altitude: 160-3,000m.
Province and type: 8.6.1/8.35.12; 09, 10, 11, 12 & 16.
Site description: Two rivers, the Rio Isiboro and the Rio Secure, and tributaries, from their sources in the yungas of the eastern Andes to their confluence in the Beni lowlands. The Isiboro is a clear water river; the Secure is turbid. Along their lower courses, the rivers meander across alluvial plains with riverine forest, shallow freshwater lakes and marshes, and seasonally inundated savanna.
Principal vegetation: Humid subtropical montane forest in the yungas; humid tropical forest along the rivers and humid savanna in the lowlands.
Land tenure: State owned.
Protection: Within the Isiboro-Secure National Park (1,233,000 ha) established in 1965. The aim of the Park is to protect the river basins in their entirity, but none of the Park regulations have ever been enforced.
Land use: Colonization is occurring in the area and the forest is being cleared for agriculture and cattle ranching.
Waterfowl: Little information is avaliable, but it seems that the avifauna is similar to that of the Rio Mamore.
Other fauna: A wide variety of mammals have been recorded including the Giant River Otter *Pteronura brasiliensis* and the dolphin *Inia geoffrensis boliviensis.*
Threats: There is no control of hunting and fishing in the Park, and poaching for the fur trade is widespread. Colonists are establishing new settlements and clearing forest in the southern

and northern parts of the Park. There is some disturbance from oil exploration, and there is a proposal to build a road across the Park, but this has been held up because of lack of finance.
Research and conservation: The region is of particular interest as a Pleistocene refuge with a high degree of endemism in the flora and fauna. The University of Cochabamba and the Centro de Desarrollo Forestal have carried out studies on the natural resources of the Park, and the University of Wisconsin made a scientific expedition to the area in 1979. The need for proper enforcement of the Park regulations before the area has been irreparably damaged is apparent.
References: IUCN (1982).
Source: Eliana Flores.
Criteria for inclusion: 2b & 3a.

Wetlands in the Beni Biological Station (28)

Location: 14°35'S, 66°20'W; northeast of San Borja, between Maniqui and Curiraba rivers, Beni Department.
Area: c.130,000 ha.
Altitude: 330m.
Province and type: 8.6.1; 09, 11, 16 & 18.
Site description: A large tract of seasonally flooded savanna flooding for five to seven months of the year, with gallery forest along the main water courses, scattered "islands" of forest and patches of low subhumid forest.
Principal vegetation: Humid forest and savanna.
Land tenure: State owned; administered by the Academia Nacional de Ciencias.
Protection: A Biological Station, established in 1982.
Land use: Extensive cattle ranching and scientific research.
Waterfowl: A very important area for waterfowl typical of the Beni savanna, notably Ardeidae, Ciconiidae, Threskiornithidae and Rallidae. Species recorded include *Anhinga anhinga, Tigrisoma lineatum, Pilherodius pileatus, Syrigma sibilatrix, Ardea cocoi*, all three Ciconiidae, *Harpiprion caerulescens, Theristicus caudatus, Phimosus infuscatus, Ajaia ajaja, Chauna torquata Dendrocygna autumnalis, D. viduata, Neochen jubata, Amazonetta brasiliensis, Cairina moschata, Opisthocomus hoazin, Aramus guarauna, Aramides cajanea, Eurypyga helias, Jacana jacana, Vanellus chilensis, Hoploxypterus cayanus, Sterna superciliaris* and *Rynchops niger*. A variety of Nearctic shorebirds occur on passage including *Bartramia longicauda.*
Other fauna: Mammals include *Hydrochoerus hydrochaeris, Pteronura brasiliensis, Lutra enudris, Tapirus terrestris* and *Blastocerus dichotomus*; reptiles include *Caiman crocodilus yacare* and *Eunectes murinus.*
Threats: The principal threat is increasing human settlement and the associated cutting of forests and burning to increase pasture land. There is also a considerable amount of illegal hunting.
Research and conservation: Five researchers with Spanish funding are currently studying the waterfowl, primates and fishes of the Biological Station as part of a broader study of the savanna and forest ecosystems. Better scientific facilities are required and proper wardening should be provided to enforce the laws, particularly with respect to human settlement.
References: Cabot *et al* (undated).
Source: Estacion Biologica de Doñana.
Criteria for inclusion: 2a & 3a.

Rio Yacuma (29)

Location: 14°12'S, 66°22'W; Ballivian and Espiritu, Beni Department.
Area: 250 km of river.
Altitude: 230m.
Province and type: 8.6.1; 09, 11 & 16.

Site description: A slow-flowing river, up to 2.5m deep, with clear water during the dry season; riverine marshes; gallery forest; and extensive areas of seasonally inundated savanna with forested "islands". Flooding occurs from November to April.

Principal vegetation: Humid tropical forest along the rivers and on higher ground, and humid savanna.

Land tenure: Privately owned.

Protection: Part of the area is protected in the Estancias Elsner Wildlife Refuge, established in 1978.

Land use: Cattle ranching.

Waterfowl: A very important area for waterfowl. The commoner species include *Mycteria americana, Jabiru mycteria, Harpiprion caerulescens, Theristicus caudatus, Phimosus infuscatus, Dendrocygna viduata, D. autumnalis, Neochen jubata, Cairina moschata, Aramus guarauna, Jacana jacana* and *Vanellus chilensis.* Other species recorded include *Cochlearius cochlearius, Agamia agami, Euxenura maguari, Ajaia ajaja, Chauna torquata* and *Amazonetta brasiliensis.*

Other fauna: Mammals include *Hydrochoerus hydrochaeris* and *Inia geoffrensis*; and reptiles include *Caiman crocodilus, Melanosuchus niger* and *Eunectes murinus.*

Threats: Excessive hunting throughout the region, and poaching in the reserve.

Research and conservation: The Instituto de Ecologia has been conducting an inventory of the fauna and flora since 1980. In 1982, a study was initiated on the potential of the fauna to adapt to man's alterations to the savanna ecosystem.

References: Beck (1983).

Source: Werner Hanagarth.

Criteria for inclusion: 2a & 3a.

Beni and Pando Lakes (30)

Location: 11°00'-14°30'S, 65°10'-67°20'W; in the Departments of Beni and Pando.

Area: Area of wetlands unknown; scattered throughout a region of 3,500,000 ha.

Altitude: 135-200m.

Province and type: 8.6.1; 09, 11, 12, 13, 16 & 18.

Site description: A vast complex of freshwater lakes, swamps, marshes and seasonally flooded grassland and forest in an area of some 3,500,000 ha between the Rio Beni and the lower Rio Mamore. The Rio Yata rises amongst a group of small permanent and seasonal lakes in the middle of the region. The Rio Beni and Rio Mamore are deep slow-flowing rivers with extensive sand banks, gallery forest, and numerous associated oxbow lakes and marshes. The principal lakes include Laguna Rogagua (35,000 ha), L. Huatunas (36,000 ha), L. Rogaguado (32,400 ha), Laguna Las Abras, L. Yusala, L. Carreras, and the lakes at the source of the Rio Yata. Most are deep permanent lakes with turbid waters, much floating vegetation, and extensive surrounding marshes. The best known lake ornithologically is Lago Tumi Chucua (500 ha), an old oxbow lake of the Rio Beni 20 km south of Riberalta. During the eight months rainy season, the riverine forest and vast areas of the adjacent Beni savanna are inundated.

Principal vegetation: Extensive beds of floating aquatic vegetation, marshes of Cyperaceae and Juncacae, humid tropical forest, and high grassland with scattered shrubs (Beni savanna).

Land tenure: The lakes are state owned; much of the intervening land is privately owned in large estancias.

Protection: The lakes and their marshes constitute the Lagunas de Beni y Pando National Reserve established in 1961, but the size of the reserve has never been stipulated, and no effective protection measures exist. The intervening land, and presumably therefore most if not all of the seasonally inundated savanna, is unprotected.

Land use: Hunting and fishing; navigation along the major rivers; cattle ranching; and some sugar cane cultivation in the north. The grasslands are periodically burned to improve the grazing. Large tracts remain difficult of access and little disturbed.

Waterfowl: An extremely important region for waterfowl, with spectacular and almost totally undisturbed concentrations of birds in many areas. The Orinoco Goose *Neochen jubata* is common, and flocks of up to 250 can still be observed. Some of the other more interesting species in the area include *Zebrilus undulatus* (recorded at L. Tumi Chucua), *Pilherodius pileatus*, *Cochlearius cochlearius*, *Agamia agami*, all three Ciconiidae, *Harpiprion caerulescens*, *Theristicus caudatus*, *Phimosus infuscatus*, *Ajaia ajaja*, *Anhima cornuta*, *Chauna torquata*, *Cairina moschata*, *Opisthocomus hoazin*, *Aramus guarauna*, *Porphyrula flavirostris*, *Heliornis fulica*, *Eurypyga helias* and *Hoploxypterus cayanus*. A variety of Nearctic shorebirds have been observed on migration including *Pluvialis dominica*, *Bartramia longicauda* and *Tryngites subruficollis*.

Other fauna: All five South American kingfishers Alcedinidae occur. Reptiles include *Caiman crocodilus yacare* and *Podocnemis* spp; fishes include *Megalamphodus rogoaguae* and *Rivulus rogoaguae* in the lakes, and *Myleus setiger*, *Prohilodus nigricans* and *Pyrrhulina beni* in the Rio Beni.

Threats: Uncontrolled hunting and fishing is causing a problem in some areas.

Research and conservation: The birds of Lago Tumi Chucua have been described by Pearson, the Alcedinidae have been studied by Van Remsen, and some basic faunal and floral investigations have been carried out, but much of the region remains very poorly known. Because the National Reserve is comprised of many separate entities, effective control is very difficult. The Reserve should be more clearly defined, and if possible consolidated with the inclusion of tracts of land separating some of the various lagoons.

References: Gyldenstolpe (1947); Niethammer (1953); Macias & Sejas (1974); Pearson (1975a & 1975b); Monje (1977); Montes (1982); IUCN (1982).

Source: Eliana Flores and J. Van Remsen.

Criteria for inclusion: 123.

Rio Madre de Dios (31)

Location: 11°00'S, 66°10'W to 11°30'S, 67°30'W; WSW of Riberalta, Pando Department.

Area: Over 200 km of river.

Altitude: 135m.

Province and type: 8.5.1; 9 & 11.

Site description: A large slow-flowing river meandering through humid tropical forest, with numerous oxbow lakes, some up to 2,000 ha in extent, and associated marshes.

Principal vegetation: In a region of humid tropical forest.

Land tenure: State owned.

Protection: None.

Land use: Navigation along the river; hunting and fishing; exploitation of rubber *Hebea brasilensis* and Brazil nuts *Bertholetia excelsa*.

Waterfowl: No information.

Other fauna: *Caiman crocodilus yacare* is known to occur.

Threats: Excessive hunting and fishing.

Source: Eliana Flores.

Criteria for inclusion: 0.

BRAZIL

INTRODUCTION

by **Paulo de Tarso Zuquim Antas, Flavio Silva, Maria Alice dos Santos Alves and Susana de Moura Lara-Resende**

Brazil, with an area of 8,511,965 sq. km, is the fifth largest country in the world. It comprises almost half of the South American continent, and borders on all the countries in the continent except Chile and Ecuador. The population of about 125 million is over half that of all South America.

The climate and topography vary greatly, but the country may be divided into five regions which, although based on political boundaries, roughly represent the major biogeographical zones. These are:

a) Northern Region: the states and territories of Amazonas, Acre, Rondonia, Roraima, Amapa, Para and Maranhao.
b) Northeast Region: the states of Piaui, Ceara, Rio Grande do Norte, Paraiba, Pernambuco, Alagoas, Sergipe and Bahia.
c) Southeast Region: the states of Minas Gerais, Espirito Santo, Rio de Janeiro and Sao Paulo.
d) Southern Region: the states of Parana, Santa Catarina and Rio Grande do Sul.
e) West-central Region: the Distrito Federal and the states of Goias, Mato Grosso and Mato Grosso do Sul.

The Northern Region includes the greater part of the Amazon Basin, the Amazon delta and adjacent coasts, the southern edge of the Guiana highlands in the extreme north, and the ecotone between the Amazon forests and the open areas of northeastern Brazil. Most of the Amazon basin has an elevation of less than 250m and is hot and humid, with an annual rainfall of between 1,500 and 3,000 mm. The greater part of the region remains under primeval humid tropical forest, although there are scattered patches of wet and dry savanna and extensive flood plain and lacustrine systems along the major rivers. The human density is extremely low, and although man has cleared large areas of forest along the navigable rivers and near the coast, enormous tracts remain almost uninhabited and unexplored.

The wetlands of the region are very poorly known, except in some of the more densely populated areas near the delta and in central Amazonia. The Amapa coast and delta region have been fairly well surveyed and are known to be very important for the manatee *Trichechus manatus* and such notable waterfowl as *Eudocimus ruber* and *Phoenicopterus ruber*, although the latter no longer breeds. Work in central Amazonia has focussed largely on aquatic mammals, turtles and fishes.

The Northeastern Region extends east from the mouth of the Rio Parnaiba, and includes the semi-arid hinterlands of northeastern Brazil with an average annual rainfall of only 600 mm, and a more humid eastern coastal strip with an average annual rainfall of 1,800 mm. The dominant vegetation type in the interior is "caatinga", which is characterized by deciduous, thorny scrubland with many cacti and other succulents, and more or less bare ground. Humid tropical forest formerly covered the coastal strip in the east, but most of this has now been cleared. There are two large perennial rivers in the region, the Sao Francisco and the Parnaiba, and many smaller rivers in the east. The extensive shoreline is comprised mainly of sandy beaches and coastal sand dunes, with mangroves in the estuaries and sea bays. In the semi-arid interior, numerous small dams have been constructed over the past one hundred years to maintain water supplies for livestock through the dry season, and these now constitute an important wetland habitat for wildlife, particularly Anatidae. In addition, there are two large dams on the Sao Francisco and one on the Parnaiba.

The wildlife of the coastal zone is relatively well known, but little work has been carried out at the wetlands in the interior, and the importance of the large dams for waterfowl is unknown. Four species of sea turtle occur along the coast, and there are some small populations of *Trichechus manatus* in the larger estuaries. *Phoenicopterus ruber* formerly occurred but is now extinct in the region, and *Eudocimus ruber* is much reduced in numbers.

However, *Netta erythrophthalma erythrophthalma*, which is listed as "Indeterminate" in the WWF Red Data Book, occurs widely at coastal lagoons and dams in Ceara, Rio Grande do Norte, Alagoas and Bahia.

The Southeastern Region is the most densely populated and industrialized part of the country. The climate is humid tropical to subtropical, with a well defined rainy season from December to March. The coastal plain and Atlantic slopes of the coastal mountain ranges were formerly forested, but extensive forest clearance for agriculture and settlement has left very little forest below 1,500m above sea level. In the interior, most of the original grassland and cerrado vegetation has been converted to pastureland for cattle or arable land. All of the large rivers have been dammed, some in many places, for hydroelectricity, irrigation and water supplies to urban areas. Along the coast, many of the coastal marshes and mangrove swamps have been reclaimed for agriculture, particularly around the main urban areas, and most of the remainder are under threat.

The wildlife of the region is well documented. The massive changes brought about in the environment by man over the past two hundred years have resulted in the extinction or near extinction of many species in the region, including waterfowl such as *Tigrisoma fasciatum, Eudocimus ruber* and *Mergus octosetaceus*. Other species have however adapted well, and a variety of waterfowl including *Dendrocygna viduata, Amazonetta brasiliensis* and various Ardeidae have been able to take advantage of the large man-made wetlands and expand their ranges in the region.

The Southern Region extends south from the Tropic of Capricorn to the border with Uruguay, and has a subtropical to temperate climate with warm summers and mild wet winters. The coastal mountain ranges of southeastern Brazil extend south to the region of Porto Alegre; thereafter the land is rolling with hills not exceeding 600m. The forested regions of the north give way to open pampas in Rio Grande do Sul and a landscape similar to that of Uruguay and Argentinian Pampas. The region is densely populated, and the standard of living is high.

This region has some of the most extensive lacustrine systems in Brazil, and the greatest diversity of waterfowl of any region; Anatidae are particularly abundant, and several species occur here at the extreme northern edge of their range. Mangroves extend south along the coast to 28°30'S; from there to the Uruguayan border the shoreline is a sandy beach backed by sand dunes and a chain of some sixty lagoons. Lagoa dos Patos, which stretches for 250 km between Porto Alegre and Rio Grande, is the largest lake in Brazil, and together with Lagoa Mangueira, Lagoa Mirim, and associated lagoons, comprises a vast wetland system with close affinities to the Rio de la Plata wetlands. Some of the more interesting waterfowl include the two swans *Cygnus melancoryphus* and *Coscoroba coscoroba*, wintering *Phoenicopterus chilensis*, and a small population of *Mergus octosetaceus* on rivers in the west.

The West-central Region is the only region to lack a coastline. The climate is continental, with an average annual rainfall of over 1,600 mm falling mainly between December and March, and a long dry season from April or May to September. The region is dominated by the central Brazilian tableland, with cerrado vegetation characterized by fairly open woodland with semideciduous, gnarled, low trees and coarse grassland. In the north, the region includes the ecotone between the humid tropical forests of the Amazon basin and the campos and cerrado of the highlands, with fingers of tropical forest extending south along the major river valleys to about 10° to 11°S. Human population density is low, and the predominant form of land use is cattle ranching on large estates.

The region includes the headwaters of several great rivers, including the Paraguay, Guapore, Tapajos, Xingu, Tocantins and Araguaia. Heavy rainfall during the summer months and impeded drainage result in extensive seasonal flooding along the main rivers, creating some of South America's largest wetlands; the Pantanal in the headwaters of the Rio Paraguay (150,000 sq. km) and the fluvial system of the middle Rio Araguaia (40,000 sq. km) are particularly impressive. Many of the wetland areas remain almost uninhabited and difficult of access, and wildlife populations are almost undisturbed. Waterfowl are particularly abundant, and several species which are becoming scarce or local in other parts of South America, still occur in large numbers.

Institutional Base for Wetland Conservation and Research

There are numerous organizations and institutions, both governmental and non-governmental, in Brazil which are concerned in some way with the environment and the conservation of natural resources. In 1982, the Ministry of the Interior published a 470 page book cataloguing over 300 bodies concerned with the environment (SEMA/SAP, 1982). At national level, the principal bodies are as follows:

Instituto Brasileiro de Desenvolvimento Florestal (IBDF): within the Ministry of Agriculture, and with headquarters in Brasilia. Established in 1967; the principal governmental organization responsible for nature conservation and research. IBDF includes the National Parks Service, and is responsible for enforcing the Game Laws and Regulations. The Centro de Estudos de Migracoes de Aves (CEMAVE) in the National Park Service conducts ornithological research and coordinates bird banding throughout Brazil. IBDF publishes the results of its research in its technical and scientific journal "Brasil Florestal".

Secretaria Especial do Meio Ambiente (SEMA): within the Ministry of the Interior, and with headquarters in Brasilia. Created in 1973 to set up and conduct research in Ecological Stations, and to conduct research on environmental pollution.

Conselho Nacional de Desenvolvimento Cientifico e Tecnologico (CNPq): with headquarters in Brasilia. Created in 1974 to promote scientific and technological research in Brazil.

Fundacao Brasileira para Conservacao da Natureza (FBCN): the largest private conservation organization in Brazil, with headquarters in Rio de Janeiro. Established in 1958 to promote the conservation of nature.

Associacao de Preservacao da Flora e Fauna (APREFFA): a private society with headquarters in Curitiba. Created in 1975 to promote nature protection and to campaign against over exploitation of wildlife and environmental pollution.

Departamento Nacional de Aguas e Energia Electrica (DNAEE): within the Ministry of Mines and Energy, with headquarters in Brasilia. Established in 1965 to study the water resources of Brazil, to evaluate their potential for hydroelectricity, and to control water pollution.

Associacao Brasileira de Engenharia Sanitaria e Ambiental (ABES): a private society with headquarters in Rio de Janeiro. Established in 1966 to campaign for improved control of environmental pollution and better basic sanitation.

At regional or state level, the principal organizations are as follows:

- Northern Region
  - *Conselho Estadual do Meio Ambiente (CEMA)*: based in Manaus; active in Amazonas.
  - *Instituto Nacional de Pesquisas da Amazonia (INPA)*: based in Manaus; active in Legal Amazonia.
  - *Museu Paraense Emilio Goeldi*: based in Belem; active in the Amazon Basin.
  - *Secretaria de Economia, Agricultura e Colonizacao - Departamento de Recursos Naturais*: based in Porto Velho; active in Rondonia.
- Northeastern Region
  - *Coordenadoria de Recursos Naturais (SENART)*: based in Sao Luis; active in Maranhao.
  - *Fundacao Instituto de Tecnologia e Meio Ambiente (SENART - ITEMA)*: based in Sao Luis; active in Maranhao.
  - *Laboratorio de Ciencias do Mar (UFCe - ABOMAR)*: based in Meireles-Fortaleza; active on the northeast coast.
  - *Superintendencia do Desenvolvimento do Estado do Ceara (SUDEC)*: based in Fortaleza; active in Ceara.
  - *Sociedade Norte Riograndense de Protecao do Meio Ambiente*: based in Natal; active in Rio Grande do Norte.
  - *Universidade Federal do Rio Grande do Norte (UFRN)*: based in Natal; active in Rio Grande do Norte.
  - *Estacao Ecologica do Tapacura - Universidade Federal do Pernambuco*: based in Sao Lourenco; active throughout the northeast.
  - *Companhia Pernambucana de Controle da Poluicao Ambiental e Administracao de Recursos Hidricos (CPRH)*: based in Recife; active in Pernambuco.

Conselho Estadual de Protecao Ambiental (CEPRAM): based in Maceio; active in Alagoas.

Administracao Estadual do Meio Ambiente (ADEMA): based in Aracaju; active in Sergipe.

Secretaria Executiva de Control de Poluicao: based in Aracaju; active in Sergipe.

Instituto de Biologia da Universidade Federal da Bahia (IB-UFBA): based in Salvador; active in Bahia.

Centro de Pesquisas e Desenvolvimento (CEPED): based in Estrada de Camacari; active in Bahia.

Southeastern Region

Instituto Estadual de Florestas (IEF): based in Vitoria; active in Espirito Santo.

Comissao de Politica Ambiental (COPAM): based in Belo Horizonte; active in Minas Gerais.

Instituto Estadual de Florestas (IEF): based in Belo Horizonte; active in Minas Gerais.

Secretaria de Estado de Ciencia e Tecnologia: based in Belo Horizonte; active in Minas Gerais.

Comissao de Controle da Poluicao da Baia de Guanabara: based in Rio de Janeiro; active in Rio de Janeiro State.

Comissao Estadual de Controle Ambiental (CECA): based in Rio de Janeiro; active in Rio de Janeiro State.

Fundacao Estadual de Engenharia do Meio Ambiente (FEEMA): based in Rio de Janeiro; active in Rio de Janeiro State.

Instituto Florestal (Secretaria da Agricultura): based in Sao Paulo; active in Sao Paulo State.

Southern Region

Associacao de Defesa e Educacao Ambiental: based in Curitiba; active in Parana.

Superintendencia dos Recursos Hidricos e Meio Ambiente (SUREHMA): based in Curitiba; active in Parana.

Fundacao de Amparo a Tecnologia e Meio Ambiente (FATMA): based in Florianopolis; active in Santa Catarina.

Coordenadoria de Controle do Equilibrio Ecologico, Superintendencia do Desenvolvimento da Regiao Sul (Ministry of the Interior): based in Porto Alegre; active in Rio Grande do Sul.

Fundacao Zoobotanica do Rio Grande do Sul (FZB): based in Porto Alegre; active in Rio Grande do Sul.

Secretaria de Saude e Meio Ambiente: based in Porto Alegre; active in Rio Grande do Sul.

Unidade de Preservacao e Controle de Recursos Naturais Renovaveis (Secretaria da Agricultura): based in Porto Alegre; active in Rio Grande do Sul.

Associacao Gaucha de Protecao ao Ambiente Natural (AGAPAN): based in Porto Alegre; active mainly in Rio Grande do Sul.

West-central Region

Companhia de Agua e Esgoto de Brasilia (CAESB): based in Brasilia; active in the Federal District.

Departamento de Botanica - ICBI: based in Goiana; active in Goias.

Superintendencia Estadual do Meio Ambiente (SEMAGO): based in Goiana; active in Goias.

Instituto de Preservacao e Controle Ambiental de Mato Grosso do Sul (INAMB): based in Campo Grande; active in Mato Grosso do Sul.

Associacao para Defesa da Flora e Fauna do Pantanal: based in Corumba; active in the Pantanal Matogrossense.

Progress in Wetland Conservation

Legislation concerning the natural environment has been in effect in Brazil since 1934. The first law specifically related to wetlands was the Codigo de Aguas (1934), which regulated the use of rivers, lakes and lagoons. Since that time, a very large number of laws concerning the environment has been adopted. In general, however, the enforcement of the laws is poor. In an attempt to educate lawyers and law enforcement personnel in environmental legislation, the Fundacao Brasileira para Conservacao da Natureza and Cia. Energetica de Sao Paulo have recently published a 510 page book summarizing all the nation's environmental legislation (Camara, Strang & Moretzsohn Rocha, 1983).

Commercial hunting has been banned throughout Brazil since 1967, and sport hunting permitted only in those states which are able to demonstrate on a scientific basis that an open season can be justified. Since 1980, the only state able to do this, and therefore the only state in which hunting has been permitted, is Rio Grande do Sul.

Some of the main laws relating to wetlands and their wildlife are as follows:

a) The Codigo de Aguas in 1934.
b) A decree in 1948 approving the Convention for the Protection of Fauna, Flora and Scenic Natural Beauty in the Americas.
c) A decree in 1961 regulating the pollution of inland and marine waters.
d) A law in 1962 creating the Superintendencia de Desenvolvimento da Pesca, the agency responsible for fisheries in Brazil.
e) A law in 1967 banning the commercial hunting of wildlife in Brazil, and establishing hunting seasons. All wildlife became the property of the Federation, and could only be hunted under permit.
f) A law in 1967 creating the Instituto Brasileiro de Desenvolvimento Florestal (IBDF), the agency responsible for nature conservation throughout the country, and for managing National Parks and Biological Reserves.
g) A decree in 1973 creating the Secretaria Especial do Meio Ambiente (SEMA), the agency responsible for Ecological Stations, and for research on environmental pollution. Ecological Stations have some similarities with Biological Reserves, and there is thus some overlap between SEMA and IBDF.
h) A decree in 1975 approving Brazil's adherence to the Convention on International Trade in Endangered Species.
i) Two decrees in 1975 relating to industrial pollution.
j) A decree in 1979 approving Brazil's adherence to the International Convention on Oil Pollution.

Considerable progress has been made in the establishment of protected areas, and by 1983, over 12 million hectares were under Federal protection in a network of National Parks, Biological Reserves and Ecological Stations. The National Parks Service in IBDF is responsible for National Parks and Biological Reserves, and can create National Forest Reserves in which forest exploitation can occur. By the end of 1983, there were 25 National Parks, 14 Federal Biological Stations, and 14 National Forest Reserves. SEMA is responsible for Ecological Stations, which are established to preserve good examples of all Brazilian ecosystems and to serve as study areas for baseline research. SEMA can also designate Environmental Protection Areas and legislate over private property in regions of special interest. By October 1983, 23 Ecological Stations had been established, and a further seven were at the planning stage. Eighteen of these areas contain important wetland habitat. At state level, some state governmental entities create and preserve State Parks and Ecological Stations. The Codigo Florestal (Law No. 4771) allows for the establishment of permanent private reserves in which land use activities are restricted. In return, the owners are exempt from Federal land taxes. Private reserves can similarly be established through the regulations of IBDF, under the name of Refugios de Fauna (Faunal Refuges).

The protected areas which include significant wetland habitat are as follows:

Northern Region

Cabo Orange National Park, on the north coast of Amapa: 619,000 ha; established 1980.

Lencois Maranhenses National Park, on the east coast of Maranhao: 155,000 ha; established 1981.

Lago Piratuba Biological Reserve, on the central Amapa coast: 395,000 ha; established 1980.

Trombetas Biological Reserve, on the Rio Trombetas in Para: 385,000 ha; established 1979.

Abufari Biological Reserve, in Amazonas: 288,000 ha; established 1982.
Guapore Biological Reserve, on the Rio Guapore in Rondonia: 600,000 ha; established 1982.
Maraca-Roraima Ecological Station, in Roraima: 92,000 ha.
Maraca-Amapa Ecological Station, on the Amapa coast: 70,000 ha.
Anavilhanas Ecological Station, on the lower Rio Negro in Amazonas: 350,000 ha.
Cunia Ecological Station, in Rondonia: 100,000 ha.
Juami-Japura Ecological Station, on the lower Rio Japura in Amazonas: 273,238 ha.

Northeastern Region
Praia do Peba Ecological Station, on the coast of Alagoas: 3,000 ha.

Southeastern Region
Serra da Canastra National Park, in the highlands of Minas Gerais: 71,525 ha; established 1972.
Parapitinga Ecological Station, in Minas Gerais: 10,000 ha.
Pirai Ecological Station, in Rio de Janeiro State: 4,000 ha.
Jureia Ecological Station, in Sao Paulo State: 30,000 ha.

Southern Region
Iguacu National Park, on the Rio Iguacu in Parana: 170,000 ha; established 1939.
Taim Ecological Station, on the south coast of Rio Grande do Sul: 32,000 ha.
Guaraquecaba Ecological Station, in Paraña: 73,640 ha.
Carijos Ecological Station, in Santa Catarina: area unknown.
Babitonga Ecological Station, in Santa Catarina: area unknown.

West-Central Region
Chapada dos Veadeiros National Park, in Goias: 60,000 ha; established 1972.
Araguaia National Park, at Ilha do Bananal on the Rio Araguaia, Goias: 562,312 ha; established 1959.
Pantanal Matogrossense National Park, in the Pantanal, Mato Grosso: 135,000 ha; established 1981.
Taiama Ecological Station, in the Pantanal, Mato Grosso: 12,000 ha.
Cocos-Javaes Ecological Station, in Goias: 37,000 ha.
Alto Guapore Ecological Station, on the upper Rio Guapore, Mato Grosso: area unknown.

Progress in Research on Wetlands and Waterfowl

A considerable amount of research has been conducted on the natural resources of Brazil, and the flora and fauna of the country are now relatively well documented. However, very little work has been done on wetland ecosystems and their wildlife except locally in Amazonas, Amapa, Para, Sao Paulo and Rio Grande do Sul. In Amazonia, the Instituto Nacional de Pesquisas da Amazonia (INPA) has been particularly active in wetlands research, with major projects on fisheries resources, crocodilians, freshwater turtles and aquatic mammals. The Aquatic Mammal Project at INPA has in the past concentrated on *Trichechus inunguis*, but in recent years has expanded the scope of its activities to include the Cetaceans and otters *Pteronura* and *Lutra*. Some limnological work has been conducted on the flood plain systems near Manaus and on the lower Rio Tapajos, and attempts have been made to interpret the aquatic resources of central Amazonia using Landsat imagery. IBDF biologists, the Goeldi Museum in Belem, and the Museu Costa Lima in Macapa have carried out investigations on *Trichechus manatus*, sea turtles and waterfowl in the delta area and along the Para and Amapa coasts.

In the south, J. G. Tundisi and colleagues of the Federal University of Sao Carlos have conducted limnological studies at man-made lakes in Sao Paulo and lacustrine systems in Rio de Janeiro (Henry & Tundisi, 1983; Matsumura-Tundisi & Tundisi, 1976; Rocha *et al*, 1982; Tundisi, 1981 & 1983a; Tundisi *et al*, 1978); and limnologists at the Federal University of Rio Grande do Sul have investigated the coastal lagoons of that state (Chomenko, 1981; Schwarzbold, 1982).

As regards research on waterfowl, very little work has been done in Amazonia, and indeed rather few researchers have specialized in this group anywhere in Brazil. Recent investigations of note include aerial surveys of the entire Brazilian coastline for wintering shorebird populations by Canadian Wildlife Service and IBDF biologists (Morrison, 1983a & 1983b); a survey of *Phoenicopterus ruber* and *Eudocimus ruber* populations on the Amapa coast by Teixeira and Best (1981); a study of game species and colonial waterbirds in the Pantanal by IBDF biologists (initiated in 1983); studies on game bird management and sport hunting in Rio Grande do Sul by biologists at the Fundacao Zoobotanica; experiments with the management of *Amazonetta brasiliensis* as a game species in Sao Paulo by a private timber company; and a detailed avifaunal survey of Rio Grande do Sul by Belton (1984). A study of the importance of Lagoa do Peixe, Rio Grande do Sul, for waterfowl, particularly wintering Nearctic shorebirds, will be initiated by S. Lara-Resende in 1985.

Brazil does however have a very active bird banding programme coordinated by CEMAVE, and this has included a number of projects involving waterfowl. Recent banding projects have included the following:

a) Colonially nesting Ardeidae, mainly *Egretta alba* and *Ardea cocoi*, in Amapa, by Antonio Carlos Farias of the Museu Costa Lima.
b) Shorebirds and Laridae, particularly *Sterna hirundo*, on the northeast coast, by biologists from CEMAVE, the Canadian Wildlife Service, the Goeldi Museum and several local universities.
c) *Sterna* spp in the Atol das Rocas Biological Reserve, by IBDF biologists.
d) *Sterna hirundinacea* in Guanabara Bay, Rio de Janeiro, by Norma Crud Maciel and Dante Teixeira.
e) Nearctic shorebirds in Rio de Janeiro, by Pedro Ernesto Correa Ventura and Elias Pacheco Coelho.
f) Anatidae, particularly *Dendrocygna viduata*, in Sao Paulo, by the Sao Paulo Zoo, the Cia. Energetica de Sao Paulo, and a private timber company.
g) Colonially nesting Ardeidae and *Anhinga anhinga* in Minas Gerais by Marco Antonio Andrade.
h) Anatidae and sea-birds in Santa Catarina, by Lenir Alda do Rosario and colleagues.
i) Anatidae and colonially nesting Ciconiiformes in Rio Grande do Sul, by Flavio Silva and colleagues.
j) Shorebirds on the southern coast, by Martin Sander of the Universidade do Vale do Rio dos Sinos.
k) Colonially nesting Ciconiiformes in the Pantanal, by the Instituto de Preservacao e Controle Ambiental in Mato Grosso do Sul.

Major Threats to Wetlands and Waterfowl

The wetlands of Brazil are under heavy human pressure. Most of Brazil's population is concentrated in the southeastern and southern regions, where the nation's largest cities and advanced industrial development pose particularly serious threats to wetland ecosystems. In other parts of the country, agricultural development, especially the cultivation of rice, is the principal threat, while in coastal zones development for recreation and the destruction of mangrove forests for timber and fuel add to the pressures on wetlands. Despite the fact that hunting has been prohibited in all states except Rio Grande do Sul since 1980, the commercial exploitation of wildlife and subsistence hunting continue everywhere at a high level and threaten many populations of preferred species with local extinction.

Northern Region

The population density remains very low almost throughout the northern region and the destruction of wetland habitat for agricultural land has had a serious impact only at a very local level; e.g. in the Sao Luis area where wetlands have been reclaimed for rice culture and pastureland. However, one habitat type, namely the floodplains of white water rivers, has come under considerable pressure because of the fertility of the soils, and this habitat has now largely disappeared from the major navigable white water rivers of central and lower Amazonia. Elsewhere in the region, illegal commercial and subsistence hunting pose the most serious threat to wetland fauna. Species under particular pressure include the crocodilians (notably *Melanosuchus niger*), the freshwater turtles (notably *Podocnemis expansa* and *P. unifilis*), the manatees *Trichechus inunguis* and *T. manatus*, and a variety of waterfowl including *Eudocimus ruber, Neochen jubata, Dendrocygna* spp and *Porphyrula martinica.* The flamingo *Phoenicopterus ruber* has become extinct as a breeding species in Brazil because of intensive persecution in the past. Pollution from pesticide runoff is beginning to affect some riverine systems, and the construction of a number of enormous dams in the coming decades will have a major impact on most of the large rivers of the region.

Northeastern Region

Most of the wetlands are situated on the densely populated coastal plain, where the large industrial centres of Salvador and Recife and many smaller cities create serious pollution problems. Almost all of the mangrove swamps are being affected by cutting and drainage, and coastal development for recreation is a problem in some areas. Illegal hunting is widespread; sea turtles, principally *Eretmochelys imbricata*, and Anatidae, principally *Dendrocygna viduata*, are particularly under pressure.

Southeastern Region

The long history of colonization, very dense human population and extensive industrial development have resulted in major changes to natural ecosystems throughout the southeast. Wetlands have been seriously affected by reclamation for agriculture and urban development, domestic and industrial pollution, contamination with pesticides and, along the coast, development for recreation and tourism. Large tracts of wetland habitat have been destroyed, and few areas remain in anything like pristine condition. Hunting, although now illegal throughout the region, continues to take a heavy toll, and several species of waterfowl have been exterminated locally or reduced to very low levels. In recent years, attempts have been made to control *Dendrocygna viduata* as a pest on rice crops, and Aldrin has been used illegally in at least one region in Sao Paulo.

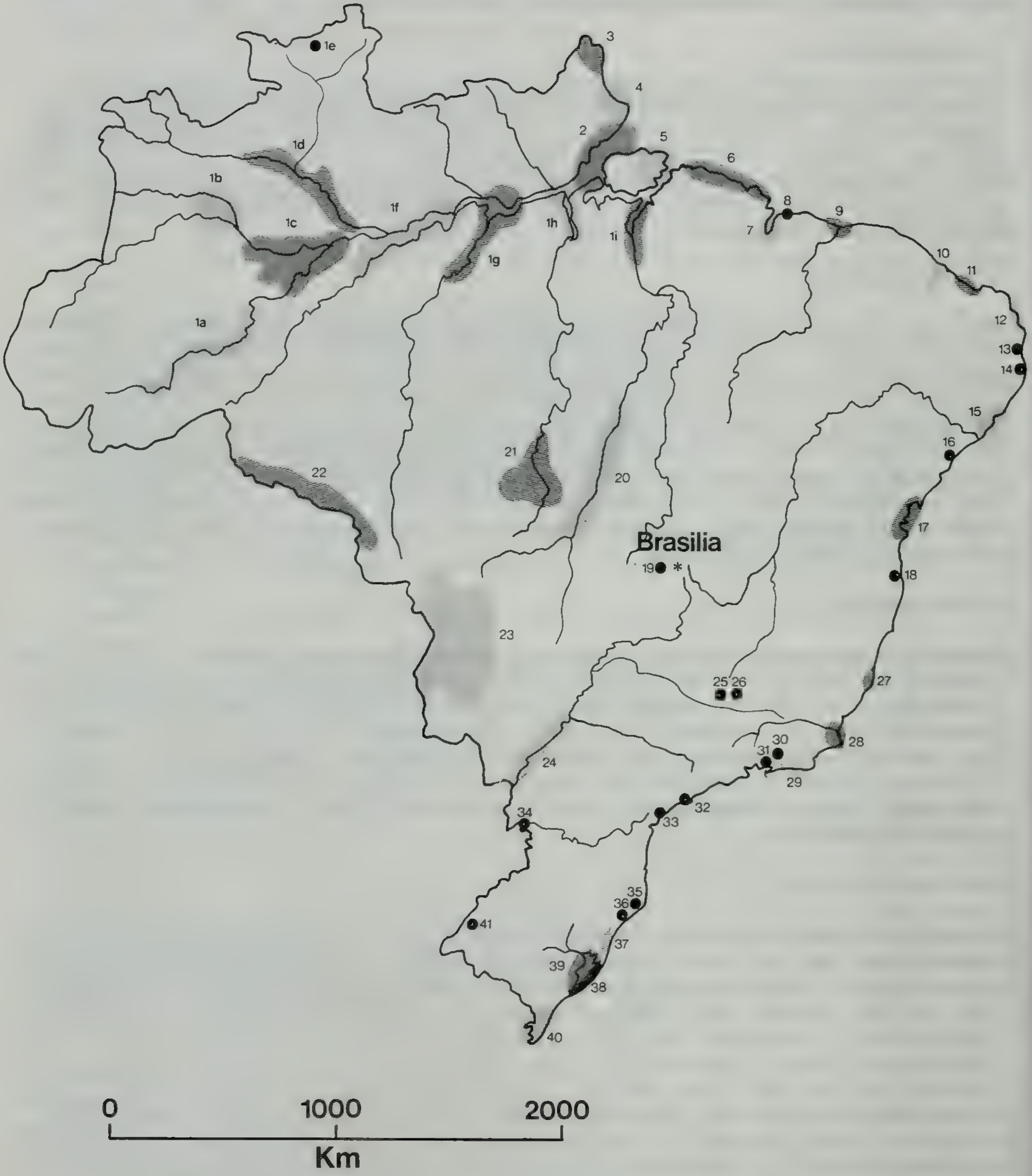
Southern Region

Wetlands in the southern region have been subjected to all the same pressures as those in the southeast, but have not to date suffered as badly. The principal threat in most areas is the reclamation of land for rice growing which continues at an accelerating pace. Overgrazing by domestic livestock is a problem in some of the ranching areas in the south. In Rio Grande do Sul, there is an open season for sport hunting of Anatidae from 15 May to the end of August (15 June to the end of September for *Netta peposaca*), and some 12,000 hunters are licensed each year. However, despite poor law enforcement and a lack of management, waterfowl populations remain high.

West-central Region

Population pressures remain low throughout much of the west-central region, and although wetlands have been reclaimed for agriculture and ranching, the total area affected to date is relatively small. However, a large expansion in agriculture is planned in the region, and areas such as the Pantanal and middle Araguaia are increasingly coming under pressure. Deforestation of watersheds has affected flooding cycles and sedimentation rates in the floodplains of the major rivers, and the widespread use of pesticides on agricultural land is also beginning to affect the riverine systems. Illegal hunting is a serious problem, particularly the commercial exploitation of *Caiman crocodilus yacare* in the Pantanal. The skins are smuggled across the border into neighbouring Bolivia to enter the international trade. Subsistence hunting of waterfowl is widespread, but it is doubtful if this is having any detrimental effect on populations. However, there are indications that avicides are being used to kill ducks, mainly *Dendrocygna* spp, in rice growing areas in the Araguaia Valley (Rio Formosa).

BRAZIL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WETLANDS

Site descriptions based on information and data sheets provided by Maria Alice dos Santos Alves, Marco Antonio de Andrade, Paulo de Tarso Zuquim Antas, Joao Henrique Auler Junior, Marlise Becker, Lenir Alda do Rosario Bege, Robin C. Best, James M. Dietz, Selma Mattos Diniz, Jean-Luc Dujardin, Antonio Carlos da Silva Farias, Luiz A. Pedreira Gonzaga, Susana de Moura Lara-Resende, Norma Crud Maciel, Pedro Scherer Neto, Marcos da Silva Noffs, Fernando C. Novaes, David Oren, Benedito Vitor Rabelo, Paul Roth, Helmut Sick, Flavio Silva, Dante Luiz Martins Teixeira, Walter A. Voss and Carlos Yamashita.

The Amazon Basin (1)

Location: 5°00'N to 11°00'S, 48°00'W to 73°00'W; the Amazon Basin from the Delta near Belem and Macapa to the borders of the Guianas, Venezuela, Colombia, Peru and Bolivia, and the highlands of central Brazil.
Area: The entire catchment is about 7,000,000 sq. km, of which nearly three-quarters (4,975,000 sq. km) lie in Brazil. No reliable estimate of the total area of wetland habitat is available. However, it has been estimated that in Brazil alone there are between 70,000 and 100,000 sq. km of floodplain habitat, and over 100,000 sq. km of lakes and swamps. There are 40,000 km of navigable stretches of river, and probably an even greater extent of wetland in the form of creeks and streams. Thus the total area of wetland in the Brazilian Amazon almost certainly exceeds 300,000 sq. km (30 million ha), and may be much more.
Altitude: 0-300m; the major wetlands of central and lower Amazonia lie below 100m above sea level.
Province and type: 8.4.1/8.5.1/8.6.1, with some 8.28.10 in the extreme north; 09, 10, 11, 12, 15, 16 & 18.
Site description: The Amazon River and its tributaries comprise the greatest riverine system on earth, discharging one sixth of the fresh water entering the world's oceans. The Brazilian portion of the Amazon Basin constitutes 58% of that country and over a quarter of the South American continent. The annual rainfall over much of the basin is between 2,000 and 3,000 mm; it exceeds 3,000 mm in the delta region in the east and in the Andean foothills in the west, and is as low as 1,600 mm in some north-central areas. Rain falls year round, with a peak between January and May and a low between July and November in the central and eastern areas.
Three major divisions of aquatic system are widely recognized:
a) Black water systems, arising on bleached sands and podzols of the central Amazon lowlands. The water is rich in dissolved humic substances, dark brownish in coloration, and transparent, with a low concentration of dissolved minerals and an extremely low pH (about 4). Black waters are amongst the most nutrient poor waters on earth and have a low productivity.
b) White water systems, arising mainly in the Andes and foothills. The water is rich in inorganic particles in suspension and turbid, with a relatively high concentration of dissolved minerals and a pH of about 7. White waters have a fairly high nutrient content, and high productivity.
c) Clear water systems, arising in the crystalline Precambrian shield of central Brazil in the south and the Guianas in the north. The water is greenish in coloration and transparent, with a very low to relatively high concentration of dissolved minerals, a pH ranging from very acid to neutral, and low to medium productivity. The two main clear water rivers are the Xingu and Tapajos.

Junk (1983) recognizes eight main wetland habitats in the Amazon Basin:
a) Rivers: all are influenced by wide fluctuations in water level. Rivers flowing south from the northern parts of the basin reach flood peaks between June and August; those flowing north into the Amazon, between February and June. The Amazon itself reaches its maximum normally at the end of June. The magnitude of the fluctuations decreases from west to east, with fluctuations of 16-20m in the Andean foothills, 8-15m at Manaus in central Amazonia, and 4-6m near the delta.
b) Creeks: the Amazon basin has the greatest density of creeks on earth. They show a great diversity in water chemistry, extent of solar irradiation, rate of flow, and permanence, and

thus constitute a very complex system of different habitats with a huge diversity of aquatic organisms. (In one study, 40 species of fishes were found in a 300m stretch of forest creek 1-2m wide.)

c) Deep closed lakes: deep lakes with more or less closed basins are rare in Amazonia. Probably the only real deep closed lake basins in the Brazilian portion are the Morro de 6 Lagos, a group of six small lakes in the highlands of the upper Rio Negro. The area is difficult of access, and the lakes have never been studied.

d) Closed shallow lakes: these are very common in the savanna areas of Roraima. Some are perennial, others temporary; they are mainly oligotrophic, but some are eutrophic and these may have extensive swamps with a great diversity of wildlife.

e) Open shallow lakes or floodplain lakes: these are shallow lakes which are connected with rivers for at least a part of the year, allowing an exchange of nutrients, energy and biological material on an annual basis. They include oxbow lakes, lateral levee lakes, lakes in abandoned channels, and lakes in depressions formed by uneven aggregations of sediments during floods. Most are subject to wide fluctuations in water level.

f) Floodplains: these are areas which for parts of the year have aspects of terrestrial habitats, but for the remainder are flooded and united with the shallow floodplain lakes. Nutrient cycles are extremely complex, and the organisms living in these transitional systems show a wide range of special morphological, physiological and ethological adaptations. Extensive flooding occurs along white water rivers, forming enormous shallow lakes up to 40 km wide and 100 km long. Along the Solimoes-Amazon alone, there are over 6,400,000 ha of this "varzea" habitat in a strip 20 to 100 km wide. The higher ground is covered with forest; the low-lying areas are primarily overgrown with bushes and grasses during the dry period. Flooding occurs to a lesser extent along black water rivers, and here the flooded regions are covered by "igapo", a characteristic type of forest which can survive flooding for several months of the year.

g) Swamps: these occur mostly along creeks and small rivers, and in long abandoned river channels where the groundwater table reaches the surface during most of the year. Although there are over 10,000,000 ha of swamps in central Amazonia, they have been little studied and their ecology remains poorly understood.

h) Man-made lakes: these include large hydro-electric dams, fish ponds and areas of rice cultivation. Only three large dams have been completed in Amazonia to date, but many more are under construction or in the planning stages. There are only small areas of fish ponds and rice cultivation at present, but these too are likely to be extended enormously in the coming decades.

Some of the most important wetland areas in the Amazon basin and the delta region are described separately below (site 1a - 1i, and site 2).

Principal vegetation: Humid tropical forest covers 68% of the Amazon basin. Non-forested terrestrial formations include dry savannas and areas of low vegetation on white sand known as campinas. Wetland habitat includes seasonally flooded forest along white water rivers (varzea); seasonally flooded forest along black water rivers (igapo); swamps with emergent macrophytes and stands of *Mauritia flexuosa*; and eutrophic lakes with fringing marshes of Cyperaceae and beds of *Eichhornia* sp, *Pistia* sp and the floating stages of *Paspalum repens*.

Land tenure: A mixture of Federal, State and private ownership.

Protection: Very little of the wetland habitat is under protection. Although a number of large National Parks, Biological Reserves and Ecological Stations have been established in wider Amazonia, and give some measure of protection to over eight million hectares, the emphasis has been very largely on preserving terra firma forests. Very little white water floodplain forest (varzea) has been protected, and no significant tracts of black water swamp forest (igapo) occur in any of the reserves. The commercial exploitation of wildlife was banned throughout the region in 1967, and full legal protection given to the manatee *Trichechus inunguis* and otters *Pteronura brasiliensis* and *Lutra enudris* in 1973, but enforcement of the regulations is almost non-existent outside the reserves.

The following protected areas have been established in the Amazon proper; all include some wetland habitat, but only the Rio Trombetas Biological Reserve, and Anavilhanas, Maraca-Roraima and Juami-Japura Ecological Stations include large tracts of important wetland habitat:

Jau National Park: 2,272,000 ha; established 1980. Along a western tributary of the Rio Negro.

Amazonia (Tapajos) National Park: 1,258,000 ha; established 1974. On the middle Rio Tapajos in southern Para and southeastern Amazonas.

Pico da Neblina National Park: 2,200,000 ha; established 1979. On the upper Rio Negro on the Venezuelan border.

Rio Trombetas Biological Reserve: 385,000 ha; established 1979. On the lower Rio Trombetas and Rio Maquera.

Abufari Biological Reserve: 288,000 ha; established in 1982. Between the Rio Purus and the Rio Coari.

Anavilhanas Ecological Station: 350,000 ha; established 1981. On the lower Rio Negro, and including a large archipelago in that river.

Maraca-Roraima Ecological Station: 92,000 ha; established 1976. An island in the Rio Uraricuera, a tributary of the Rio Negro, in the extreme north.

Rio Acre Ecological Station: 77,500 ha; established 1981. On the Rio Acre, a tributary of the Rio Purus, on the Peruvian border.

Apiacas Ecological Station: 500,000 ha; date of establishment unknown. On the middle Rio Tapajos, in the transition zone between humid tropical forest and cerrado.

Cunia Ecological Station: 100,000 ha; date of establishment unknown. On the upper Rio Madeira in northern Rondonia.

Juami-Japura Ecological Station: 273,238 ha; date of establishment unknown. On the lower Rio Japura near its confluence with the Solimoes-Amazon.

Land use: The human population of the Amazon Basin is extremely low, with an estimated total of only six million inhabitants in the entire basin of 7,000,000 sq. km. However, almost the entire population is concentrated along the main water courses and is very largely dependent on the rivers for transportation, and the floodplains for cultivation. There is a very important subsistence and commercial fishery; it has been estimated that the potential of the Amazon could exceed 600,000 metric tons of fish per year, but only a small fraction of this is currently being harvested. Fish farming in fish ponds is being attempted in some areas, and this activity is likely to increase enormously in the future. Agriculture is generally at a very primitive subsistence level except around the main centres of habitation where maize, rice and jute are the principal crops. Rice production is however increasing rapidly and is likely to take over large areas of floodplain in the future. There is also some cattle ranching in open areas.

Hunting for food and for skins has long been an important activity in much of the Amazon and has focussed on the readily accessible wildlife of the rivers and riverbanks. There was a massive trade in skins of crocodilians, Capybara *Hydrochoerus hydrochaeris* and otters in the 1950s and 1960s, but with the virtual extermination of some species over much of their ranges and the introduction in 1967 of legislation prohibiting commercial hunting, the level of harvest has dropped off considerably. Freshwater turtles continue to be harvested for food on a large scale, although the preferred species *Podocnemis expansa* is becoming increasingly rare.

Waterfowl: The waterfowl of Amazonia have received remarkably little attention from ornithologists or ecologists, perhaps because they show none of the interesting speciation phenomena associated with Pleistocene forest refugia which have captivated so many biologists working in the Amazon in recent decades. In fact, the aquatic avifauna of the Amazon is extremely homogeneous; of the 30 species typical of rivers, creeks, oxbow lakes and wet forest, all but two occur throughout the Amazon Basin. Thus even those species which occur at very low densities, such as *Zebrilus undulatus* and *Agamia agami*, must, in terms of total population size, be relatively common birds.

Characteristic species include *Phalacrocorax olivaceus, Anhinga anhinga, Tigrisoma lineatum, Zebrilus undulatus, Pilherodius pileatus, Egretta alba, Ardea cocoi, Agamia agami, Mesembrinibis cayennensis, Anhima cornuta, Neochen jubata, Cairina moschata, Opisthocomus hoazin, Aramides cajanea, Laterallus exilis, L. melanophaius, Porphyrula martinica, Heliornis fulica, Eurypyga helias, Jacana jacana, Hoploxypterus cayanus, Charadrius collaris, Phaetusa simplex, Sterna superciliaris* and *Rynchops niger*. The two humid forest species with restricted ranges in western Amazonia are *Aramides calopterus* and *Laterallus fasciatus*.

A variety of species typical of large open wetlands such as the llanos of Venezuela or Pantanal of central Brazil have a rather patchy distribution in Amazonia, dependent on the presence of open lacustrine and floodplain systems or wet savannas. These include several Ardeidae, the three storks Ciconiidae, *Theristicus caudatus, Ajaia ajaja, Dendrocygna viduata, D. autumnalis, Amazonetta brasiliensis, Sarkidiornis melanotos, Oxyura dominica, Aramus guarauna, Vanellus chilensis* and *Himantopus himantopus*.

Several species of Nearctic shorebirds cross Amazonia on a broad front on their way to and from wintering areas further to the south. Although few areas hold large numbers of birds at any one time, every wide river, floodplain lake and swamp provides some habitat for shorebirds during the migration seasons, and the basin as a whole must constitute a vital refuelling area for large sections of the entire population of some species. The principal species involved are *Pluvialis dominica, Bartramia longicauda, Tringa melanoleuca, T. flavipes, Calidris fuscicollis, C. melanotos, Micropalama himantopus* and *Tryngites subruficollis.* Two species *Tringa solitaria* and *Actitis macularia* remain in the Amazon throughout the northern winter, this constituting an important wintering area for these species.

Because of the extent and relatively undisturbed nature of the wetland habitats, and the low human population density, none of the species typical of the Amazon are in any forseeable danger of extinction except for the Orinoco Goose *Neochen jubata.* As an inhabitant of wide rivers and riverbanks, this popular game species and surprisingly confiding bird has been particularly susceptible to hunting pressure, and has now disappeared from most of the navigable rivers of Amazonian Brazil.

Other fauna: The manatee *Trichechus inunguis* occurs widely in the Amazon Basin, but in much reduced numbers as a result of excessive hunting in the 1950s and 1960s. It has recently been introduced into the Curua-una Dam near Santarem to control the spread of aquatic vegetation. The two Cetaceans *Sotalia fluviatilis* and *Inia geoffrensis* are still common and widespread. The two otters, *Pteronura brasiliensis* and *Lutra enudris*, are much reduced in numbers as a result of intensive hunting in the past; the former is now confined to the remotest areas, and is thought to be the most endangered mammal in Amazonia. Despite heavy hunting pressure, the Capybara *Hydrochoerus hydrochaeris* is thriving, as forest clearance for agriculture and ranching provides increased foraging.

The two larger crocodilians *Caiman crocodilus* and *Melanosuchus niger* are still widespread and *C. crocodilus* remains fairly common despite heavy hunting pressure, particularly in the 1950s and 1960s. *M. niger* is rare in all accessible unprotected areas, but some populations are beginning to recover under protection. Freshwater turtles include *Podocnemis expansa, P. unifilis, P. dumeriliana, P. erythrocephala, P. sextuberculata, Chelus fimbriatus* and *Platemys platycephala.* The larger *Podocnemis* have been subjected to heavy hunting pressure; *P. expansa* is now rare in many areas, and *P. unifilis* is declining, but the other commonly persecuted species, *P. dumeriliana*, remains common on black water and clear water streams in the Rio Negro basin.

Some 1,500 species of fishes have been described, and it is supposed that about 2,000 occur. Some of the economically more important species include *Astronotus ocellatus, Colossoma macropomum, Apapaima gigas* and *Cichla* spp. Piranhas *Serrasalmus* spp are ubiquitous. The aquatic invertebrates are very poorly known; recent studies have indicated that in some families, up to 80% of the species remain undescribed.

Threats: Traditional land use activities in the Amazon basin, such as slash and burn agriculture, timber extraction, rubber collection and hunting have concentrated on the riverine forests and floodplains which have always been readily accessible by way of the extensive network of navigable rivers. White water varzeas with their fertile soils have been the most seriously affected by human colonization and have almost completely disappeared from large areas in eastern Amazonia. However the black water floodplains are also increasingly coming under pressure, and as they have very little potential for agriculture or animal husbandry, their utilization is creating great ecological damage without providing any long term benefits. The threats to floodplain ecosystems are likely to increase greatly in the coming decades as these regions have been declared areas for intensive colonization and utilization for agriculture and ranching. Experiments with rice culture in the varzea have yielded positive results and there is likely to be a great increase in this form of cultivation in the near future.

The other serious threat at present is the massive programme of dam building for hydroelectric power. As many as 40 dam projects have been put forward, affecting every major river in the basin. Three large dams have already been completed; the Curua-una Dam near Santarem in Para (10,000 ha), the Paredao Dam on the Araguari River in Amapa (10,000 ha), and the Tucurui Dam on the Tocantins River in Para (246,000 ha). Dams already under construction or in an advanced planning stage include the Balbina Dam on the Uatuma River (210,000 ha); the Samuel Dam on the Jamari (64,500 ha); the Porteira Dam on the Trombetas (140,000 ha); and the Babaquara Dam (610,000 ha) and Cararo Dam (120,000 ha) on the Xingu. These enormous dams will have a profound effect on the ecology not only of the rivers themselves but also of large tracts of surrounding land. Insufficient information is available to predict the full consequences of these projects, but it is clear that flood cycles downstream of the dams will be reduced or eliminated, and the water chemistry, sediment load and discharge of the rivers will be altered. Many fish species make long spawning migrations which will be disturbed or completely interrupted by dam construction on some rivers. The Curua-una dam has been studied for several years, and the negative effects already observed include changes in fish fauna, mass development of aquatic macrophytes, and deterioration in water quality, principally in the form of a high oxygen deficit. Intensive studies were conducted in the Tucurui area prior to the construction work, and thus some baseline material is available to permit a better assessment of the impact of that dam.

Other threats include deforestation in the catchment areas causing changes in the amount of discharge, sediments and dissolved substances in the rivers, and pollution from industrial wastes and pesticides from agricultural land. Pollution is a particularly serious problem on floodplains because contaminants deposited during periods of high water are likely to enter terrestrial food chains when the water recedes. Defoliant sprays have been used to clear forest at dam construction sites, and the effects of this have been felt far downstream.

A great expansion in fish culture creates a potential threat to the native fauna, with the possible spread of diseases and parasites, and the introduction of exotic species. Tilapias have already escaped into the wild in parts of Amazonia.

Excessive hunting, although illegal, continues to threaten some species, particularly the crocodilians, larger freshwater turtles and otters. The Cetaceans have never been seriously persecuted in the past, but they could be affected by the new fishing methods being introduced into the region, and an FAO report in 1961 went so far as to suggest that they be controlled as predators on fish stocks.

Research and conservation: A considerable amount of research has been conducted by the Instituto Nacional de Pesquisas da Amazonia (INPA) based in Manaus. Attention has focussed on the fisheries resources, crocodilians, freshwater turtles and aquatic mammals, and relatively little work has been done on wetland ecosystems as such or wetland ecology. The Aquatic Mammal Project initiated at INPA in 1974 has been particularly active in studies on the status, biology, management and conservation of the manatee *Trichechus inunguis*, Cetaceans and otters, and plans to expand this work in the future. One aspect of the work has been the identification of critical areas for these species with a view to the establishment of appropriate wetland reserves.

The limnology of the floodplain lakes around Manaus is relatively well known, and a detailed study of the limnology of the lakes on the lower Rio Tapajos has been made, but generally the limnology of Amazonian wetlands is very poorly studied. Goulding (1980) looked at the importance of floodplains for fish populations, and concluded that about 75% of the commercial fish catch in the Amazon depends on food chains originating in the flooded forests. Junk (1975 & 1983) has discussed the fisheries resources and wetland habitats of Amazonia, and Bayley and Moreiras (1978) made preliminary interpretations of the aquatic resources of the central Amazon Basin using Landsat imagery.

Despite the volume of research which has already been carried out in the Amazon, there remains an urgent need for a large scale project on the overall importance of the floodplain ecosystems for wildlife, fisheries production and agriculture.

The general problems for conservation in the wider Amazon Basin have recently been reviewed by Barrett (1980). Wetterberg *et al* (1976) made recommendations concerning priority areas for conservation, and identified thirty sites totalling 17,500,000 ha. In 1979, this proposal was incorporated in a proposed system for conservation units in Brazil adopted by the Federal Government. However, the emphasis was on forest refugia and terrestrial wildlife. It has often been assumed that the protection of the terrestrial ecosystems in Amazonia will automatically include an adequate protection of wetland habitats, but there is no reason to suppose that the theory of forest refugia should apply to aquatic communities; indeed, this seems unlikely to be the case in a contiguous riverine system.

As Junk (1983) points out, the protection of riverine systems poses several special problems:

rivers and floodplains are densely colonized and utilized for agriculture, animal husbandry and timber extraction;

the rivers themselves are used for transportation and fisheries, and will in many cases in the future be used for the generation of hydroelectricity;

pollution or changes in the discharge and sediment load in unprotected areas may have dramatic effects in distant protected areas;

rivers and creeks are open systems, transporting organisms by drift, or allowing active migration over long distances.

For adequate conservation of the system as a whole, it is essential that well defined aquatic habitats including entire watersheds, lake systems and archipelagos be protected in different sections of the main rivers. In addition, large reserves should be created in the floodplains so that adequate tracts of varzea and igapo are preserved to maintain commercially important fisheries and turtle populations.

References: A very extensive literature exists on the Amazon Basin, and much of this has been listed by Junk (1975 & 1983) and Barrett (1980). Sources utilized in the present account include: Antas (1983); Barrett (1980); Bayley & Moreiras (1978); Best (1984); Costa (1983); Domning (1982); Goulding (1980); Hueck (1978); IUCN (1982); Junk (1975 & 1983); Kempf (1984); Marigo (1979); MINTER & SEMA (1977); Rebelo & Magnusson (1983); Rylands & Mittermeier (1983); Smith (1979 & 1980-1981); and Wetterberg *et al* (1976). Other publications relevant to the wetlands include Sioli (1964 & 1965); Marlier (1967); Schmidt (1973); Fittkau *et al* (1975); Rai (1978 & 1979); Rai & Hill (1981); Zaret *et al* (1981); Fittkau (1983); and Leopoldo (1983).

Source: See references.

Criteria for inclusion: 123.

The middle Rio Purus (1a)

Location: 5°45'S, 64°25'W to 9°00'S, 68°35'W; the middle course of the Rio Purus from Sena Madureira downstream for 750 km to the Rio Tapaua, Amazonas.

Area: Approximately 50,000 ha of lakes along 750 km of river.

Altitude: 60-130m.

Province and type: 8.5.1; 09, 11 & 18.

Site description: A slow flowing white water river with adjacent seasonally flooded varzea forest, in humid tropical lowlands. The river is remarkable for its extremely meandering course and the high number of associated oxbow lakes and abandoned river channels. There are at least 150 lakes in excess of 200 ha, and several between 1,000 and 2,000 ha. Maximum flooding occurs in February.

Principal vegetation: Humid tropical forest and varzea forest.

Land tenure: No information.

Protection: None; the middle Purus was identified as a priority area for conservation by Wetterberg *et al* (1976).

For other information see (1).

Lakes on the lower Rio Japura (1b)

Location: 1°25'-2°55'S, 65°02'-67°25'W; near the confluence of the Rio Japura and Rio Solimoes, Amazonas.

Area: c.67,000 ha of lakes.

Altitude: 70m.

Province and type: 8.5.1; 09, 11, 12 & 18.

Site description: A group of about 65 large freshwater lakes along the lower Rio Japura and between it and the Rio Solimoes, near the confluence of the two rivers. The Rio Auati Parana linking the Japura and the Solimoes cuts across the middle of the area. The principal lakes are: Lago de Maracai (3,800 ha); Lago Marimari (1,400 ha); Lago Parica (6,400 ha); Lago Panaua (2,200 ha); Lago Angaiara (2,900 ha); Lago de Guedes (3,400 ha); and Lago Jauato (1,800 ha). The Solimoes is a white water river with numerous islands and sand banks, and extensive areas of seasonally flooded varzea forest; the Japura is a black water river with igapo forest.

Principal vegetation: Humid tropical forest and varzea forest.

Land tenure: No information.

Protection: Largely included within the recently established Juami-Japura Ecological Station (273,238 ha). This area was listed as a priority area for conservation by Wetterberg *et al* (1976).

Land use: No information.

Waterfowl: Known to be a very important breeding area for resident waterfowl and staging area for migrant Nearctic shorebirds.
Other fauna: The entire wild population of the monkey *Cacajao calvus calvus* occurs in the forests of this region, and *Melanosuchus niger* is still relatively common.
For other information see (1).

The lower Rio Solimoes and lower Rio Purus (1c)

Location: 2°30'-4°30'S, 60°00'-65°00'W; the Solimoes-Amazon from the Rio Japura to the Rio Negro, and the lower Rio Purus, Amazonas.
Area: c.2,500,000 ha of wetlands including 350,000 ha of large lakes.
Altitude: 25-70m.
Province and type: 8.5.1; 09, 11, 12, 16 & 18.
Site description: A vast complex of broad river channels, islands and seasonally inundated varzea forest with hundreds of permanent and seasonal floodplain lakes, along 650 km of the Rio Solimoes from its confluence with the Japura to its confluence with the Negro, and along the lower 150 km of the Rio Purus. Maximum flooding occurs between February and May, and water levels are lowest between July and December. The principal lakes are: Lago Amana (19,100 ha); Lago Urini (4,100 ha); Lago de Tefe (16,100 ha); Lago Caiambe (4,100 ha); Lago de Coari (75,000 ha); Lago Mamia (24,700 ha); Lago Piorini (36,000 ha); Lago Badajos (24,000 ha); Lago Aiapu (20,000 ha); Lago Paricatuba (2,700 ha); and Lago Grande de Manacapuru (31,500 ha).
Principal vegetation: Humid tropical forest, varzea forest and some seasonally flooded grassland.
Land tenure: A mixture of federal and private ownership.
Protection: None; the Abufari Biological Reserve (288,000 ha), established in 1982, lies to the south, between the Rio Purus and Rio Coari.
Land use: Subsistence hunting and fishing, and agriculture on a small scale.
Waterfowl: Little information is available: some of the most important areas for waterfowl appear to be Lago Manacapuru, Lago Badajos and Lago Piorini. Large concentrations of *Dendrocygna* spp and *Rynchops niger* have been recorded at Manacapuru, and *Neochen jubata* still occurs in the Badajos area.
Other fauna: An important area for *Trichechus inunguis.* The Abufari Biological Reserve is particularly important for *Podocnemis expansa.*
Source: Paulo de Tarso Zuquim Antas, Robin C. Best and Susana de Moura Lara-Resende.
For other information see (1).

The lower Rio Negro (1d)

Location: 0°10'-3°00'S, 60°20'-65°00'W; the lower Rio Negro from Tapuruquaru to its confluence with the Solimoes-Amazon at Manaus, Amazonas and Roraima.
Area: c.1,640,000 ha, including 1,240,000 ha of rivers and islands, and 400,000 ha of lakes and swamps.
Altitude: 25-70m.
Province and type: 8.5.1; 09, 11, 12, 16 & 18.
Site description: The lower 650 km of the Rio Negro, a black water river up to 20 km wide, with countless large and small islands, numerous channels, sandy beaches, and an extensive floodplain system with permanent and seasonal lakes and swamps, igapo forest and seasonally flooded grassland. There are hundreds of oxbow lakes and associated swamps along the lower courses of the Rio Branco, Rio Araca and Rio Unini, which enter the Negro in this area. The Anavilhanas Archipelago, a group of large and small islands in the Rio Negro, lies 100 km northwest of Manaus, and is about 90 km long and 15 km wide.
Principal vegetation: Humid tropical forest, igapo swamp forest, seasonally inundated "campinarana" grassland, and swamps.
Land tenure: The Anavilhanas Archipelago is owned by SEMA.

Protection: The Anavilhanas Archipelago and a large area of adjacent terra firma forest are included in the Anavilhanas Ecological Station (350,000 ha) established in 1981; part of the western bank of the Rio Negro is included in the Jau National Park (2,272,000 ha) established in 1980.
Land use: All land use activities are prohibited in the Ecological Station.
Waterfowl: One of the richest areas for waterfowl in the Amazon, with a wide variety of resident species and large numbers of Nearctic shorebirds during the migration seasons.
Other fauna: The rich mammalian fauna includes *Pteronura brasiliensis*, *Trichechus inunguis* and *Hydrochoerus hydrochearis*. *Melanosuchus niger* and *Caiman latirostris* are relatively common.
Source: Joao Henrique Auler Junior, Susana de Moura Lara-Resende and David Oren.
For other information see (1).

Ilha Maraca (1e)

Location: 3°15'-3°35'N, 61°22'-61°58'W; 120 km WNW of Boa Vista, Roraima Federal Territory.
Area: 92,000 ha.
Altitude: 150m.
Province and type: 8.28.10; 09, 11, 12, 16 & 18.
Site description: An island between the Santa Rosa and Maraca channels of the Rio Uraricoera, in a transition zone between savannas and humid tropical forest, with numerous water courses, freshwater lakes, swamps, palm groves, swamp forest (igarape), and seasonally inundated grassland.
Principal vegetation: Humid tropical forest, wet savanna, dense formations of *Mauritia vinifera*, and swamps with abundant aquatic vegetation.
Land tenure: Owned by SEMA.
Protection: Comprises the Maraca-Roraima Ecological Station (92,000 ha) established in 1976.
Land use: An ecological research station, only slightly modified by man.
Waterfowl: An important area for waterfowl of both swamp forest and wet savanna. Significant numbers of Nearctic shorebirds occur on migration.
Other fauna: The area has a very diverse avifauna. Mammals include *Pteronura brasiliensis* and *Tapirus terrestris*.
Source: Joao Henrique Auler Junior and David Oren.
For other information see (1).

The central Amazon and lower Rio Madeira (1f)

Location: 1°15'-4°15'S, 55°40'-59°55'W; the Amazon from near Manaus to Obidos, and the lower Rio Madeira from the Borba region, Amazonas and Para.
Area: Over 3,000,000 ha.
Altitude: 10-70m.
Province and type: 8.4.1/8.5.1/8.6.1; 09, 11, 12, 16 & 18.
Site description: A vast complex of broad river channels, sandy beaches, large and small islands, shallow freshwater lakes, swamps, varzea forest and seasonally flooded grassland in a belt 30-80 km wide along the Amazon River from its confluence with the Rio Negro 550 km downstream to the region of Obidos; and similar habitat along the lower 100 km of the Rio Madeira and lower stretches of the Rio Preto da Eva, Rio Urubu, Rio Uatuma, Rio Nhamunda, Rio Trombetas, Rio Maues Acu, Rio Canuma and Rio Madeirinha. There are several large lakes, including Lago de Erepecu (15,000 ha) and Lago Batata (8,500 ha) on the lower Rio Trombetas, and hundreds of smaller lakes throughout the region.
Principal vegetation: Humid tropical forest, varzea forest, seasonally flooded grassland, and lakes and swamps with abundant aquatic vegetation.
Land tenure: The Rio Trombetas Biological Reserve is largely owned by IBDF; important wetland areas between Nhamunda and Juruti are in an area under dispute between the states of Amazonas and Para.

Protection: The lower Rio Trombetas, lower Rio Maquera and Lagoa Jacare are included in the Rio Trombetas Biological Reserve (385,000 ha) established in 1979; the remainder of the area is unprotected.
Land use: Subsistence hunting, fishing and agriculture.
Waterfowl: A very important area for a wide variety of resident and migratory waterfowl. Ilha Tupinambarana, a large island with lakes, varzea forest and seasonally inundated grassland in the Rio Solimoes, is particularly important for Nearctic shorebirds, and is thought to be one of the most important wetland areas for waterfowl in the Amazon. *Numenius borealis* was collected there at the end of the 19th century.
Other fauna: Mammals include *Pteronura brasiliensis, Lutra enudris, Trichechus inunguis* and *Hydrochoerus hydrochaeris*; reptiles include *Caiman crocodilus* and *Melanosuchus niger*. There are important nesting beaches for *Podocnemis expansa* in the Rio Trombetas Biological Reserve.
Source: Paulo de Tarso Zuquim Antas and Robin C. Best.
For other information see (1).

The lower Rio Tapajos and adjacent Amazon (1g)

Location: 1°45'-4°50'S; 53°30'-55°50'W; the Rio Tapajos from its mouth upstream for 350 km, and the Rio Amazon between Obidos and Prainha, Para.
Area: c.1,325,000 ha (350,000 ha along Tapajos, 975,000 ha along Amazon).
Altitude: 10-60m.
Province and type: 8.6.1; 09, 11, 12, 16 & 18.
Site description: The lower stretches of the Rio Tapajos, with extensive tracts of seasonally flooded igapo forest; and a vast complex of sand banks, islands, freshwater lakes, marshes and varzea forest along the Amazon between Obidos and Prainha. The principal lakes are Lago Grande do Curuai (40,000 ha), Lago Itandena (30,000 ha), Lago Piracacira (8,500 ha) and Lago Grande (25,000 ha). Water levels in the Rio Tapajos are highest between February and May, and lowest between July and December.
Principal vegetation: Varzea and igapo forest rich in *Euterpe oleracea* and *Mauritia flexuosa*, with adjacent humid tropical forest.
Land tenure: No information.
Protection: Unprotected except for the southernmost 90 kms of the Rio Tapajos which are included in the Amazonia (Tapajos) National Park (1,258,000 ha) established in 1974.
Land use: No information.
Waterfowl: Very little information available, but known to be an important area for passage Nearctic shorebirds.
Other fauna: Wildlife recorded in the National Park includes *Pteronura brasiliensis, Sotalia fluviatilis, Inia geoffrensis, Trichechus inunguis, Tapirus terrestris, Melanosuchus niger, Caiman crocodilus, Podocnemis expansa* and *P. unifilis*.
Source: Paulo de Tarso Zuquim Antas.
For other information see (1).

The lower Rio Xingu (1h)

Location: 1°30'-3°00'S, 51°55-53°05'W; the lower Rio Xingu from Belo Monte 180 km to the Rio Amazon, Para.
Area: c.420,000 ha (150,000 ha of river, 270,000 ha of marshes and swamp forest).
Altitude: 10-60m.
Province and type: 8.6.1; 09, 11, 12, 16 & 18.
Site description: The broad lower stretches of the Xingu, over 10 km wide, with numerous sandy beaches and small islands, and an extensive area of marshes and seasonally flooded grassland to the west of its confluence with the Amazon. The river reaches its highest levels in February.
Principal vegetation: In humid tropical forest.
Land tenure: No information.

Protection: Turtle nesting beaches north of Altamira are protected during the breeding season; otherwise the area is unprotected.
Land use: Fishing and some agriculture.
Waterfowl: Little information available, but known to be important for passage Nearctic shorebirds.
Other fauna: *Inia geoffrensis, Trichechus inunguis* and *Caiman crocodilus* are known to occur. The beaches at Volta Grande do Rio Xingu north of Altamira are particularly important for nesting *Podocnemis expansa.*
Source: Paulo de Tarso Zuquim Antas.
For other information see (1).

The lower Rio Tocantins (1i)

Location: 1°50'-3°25'S, 49°10'-49°45'W; the lower Rio Tocantins from Ilha Grande de Jutai to its mouth in the Rio Para, Para.
Area: 205,000 ha of river and islands.
Altitude: 0-30m.
Province and type: 8.6.1; 09, 11, 12, 16 & 18.
Site description: The broad lower stretches of the Rio Tocantins, up to 15 km wide, with hundreds of small islands and sand banks. This stretch of river lies below the recently completed Tucurui Dam, and will be greatly affected by the dam.
Principal vegetation: In humid tropical forest.
Land tenure: No information.
Protection: None.
Land use: No information.
Waterfowl: Little information available, but known to be important for passage Nearctic shorebirds.
Other fauna: *Trichechus inunguis* is reported to occur.
Source: Paulo de Tarso Zuquim Antas.
For other information see (1).

The Amazon Delta (2)

Location: 1°10'N-1°35'S, 49°20'-51°55'W; the main channels of the Amazon west of Ilha Marajo, Para.
Area: 3,500,000 ha of river and islands.
Altitude: 0-15m.
Province and type: 8.6.1; 02, 03, 05, 06, 07, 08, 09, 16 & 18.
Site description: A vast complex of broad river channels, large and small low-lying islands, mangrove swamps, intertidal mudflats, brackish lagoons and marshes, palm swamps and seasonally flooded grassland and swamp forest. The region extends from the southwest tip of Ilha Grande de Gurupa 350 km northeast to Ilha do Brique, Ilha Janauco, Ilha Caviana, Ilha Mexiana and western Ilha Marajo. The maximum tidal variation is about 8m.
Principal vegetation: Extensive mangrove swamps, brackish grassy marshes, and palm swamps with *Euterpe oleracea, Raphia taedigera, Manicaria saccifera* and *Mauritia flexuosa.*
Land tenure: Mainly privately owned.
Protection: None.
Land use: Fishing; livestock rearing in some areas; and hunting.
Waterfowl: Known to be rich in waterfowl, but no detailed surveys have been made. 7,500 *Eudocimus ruber*, 2,000 *Dendrocygna autumnalis* and several thousand Nearctic shorebirds were observed in the Ilha Caviana and Ilha Mexiana area in January 1982. *Phoenicopterus ruber* occurs as a non-breeding visitor in small numbers.
Other fauna: There is still a significant population of *Trichechus inunguis* in the area, and this continues to be hunted, (at least 17 killed in 1977). *T. manatus* may also occur. The turtle *Kinosternon scorpioides* is common and locally important as a source of food.

Threats: No information.
Research and conservation: Despite the obvious importance of the vast mangrove systems, the area remains very poorly studied.
References: Smith (1979); Domning (1981); Morrison (1983a); Morrison *et al* (1985).
Source: Paulo de Tarso Zuquim Antas and Dante Luiz Martins Teixeira.
Criteria for inclusion: 123.

Cabo Orange and Rio Cassipore Marshes (3)

Location: 2°30'-4°24'N, 50°50'-51°38'W; on the north Amapa coast, south from the French Guiana border to the region of Calcoene, Amapa Territory.
Area: c.580,000 ha.
Altitude: 0-5m.
Province and type: 8.4.1; 02, 06, 07, 08, 09, 13, 16 & 18.
Site description: The estuarine systems of the Rio Oiapoque (Oyapock), Rio Cassipore and Rio Uaca, with extensive intertidal mudflats and mangrove swamps; and a vast area of fresh to brackish lagoons, including Lago Maruani, and seasonally flooded savannas with palm groves, swamp forest and islands of humid tropical forest. The tidal rise and fall is up to 9m; the rainy season is from February to June.
Principal vegetation: Mangrove swamps with *Rhizophora mangle, Avicennia germinans* and *Laguncularia racemosa*; swamps with *Montrichardia arborescens* and *Mauritia flexuosa*; palm savannas with *Euterpe oleracea, Chrysobalanus icaco* and species of *Echinoa, Panicum, Paspalum* and *Oryza.* In the transition zone between humid tropical forest and open campos.
Land tenure: The National Park is owned by Amapa Territory; adjacent areas are within the Oiapoque Indian Reservation.
Protection: Cabo Orange National Park (619,000 ha), established in 1980, includes the greater part of the area and 120,000 ha of adjacent marine habitats. The remainder is within the Oiapoque Indian Reservation.
Land use: Access to the National Park is difficult, and the area is little disturbed. There is some cattle ranching and agriculture in adjacent areas.
Waterfowl: A very rich area for waterfowl, with large resident populations of *Phalacrocorax olivaceus, Anhinga anhinga*, many Ardeidae, all three Ciconiidae, *Theristicus caudatus, Mesembrinibis cayennensis, Eudocimus ruber, Ajaia ajaja, Dendrocygna autumnalis, Cairina moschata, Opisthocomus hoazin, Aramus guarauna*, various Rallidae, *Heliornis fulica, Jacana jacana, Vanellus chilensis* and *Rynchops niger.* A breeding colony of 1,000 pairs of *E. ruber* was located in 1971, and a total of 1,276 birds were observed at this site and at site 4 during an aerial survey in January 1982. *Phoenicopterus ruber* occurs regularly in small numbers, but there has been no evidence of breeding since 1971. *Anhima cornuta* was observed in 1983 near the French Guianan border.
The area is very important for passage and wintering Nearctic shorebirds: in an aerial survey in January 1982, over 28,000 shorebirds were observed along the Amapa coast, mainly small *Calidris* species but also significant numbers of *Pluvialis squatarola, Numenius phaeopus* and *Tringa* spp.
Other fauna: *Trichechus manatus, Hydrochoerus hydrochaeris, Chelonia mydas* and *Dermochelys coriacea* occur in the National Park.
Threats: None known.
Research and conservation: Several avifaunal surveys have been conducted but otherwise the region remains poorly known.
References: Spaans (1975a); Teixeira & Best (1981); IUCN (1982); Antas (1983); Morrison (1983a); Dujardin (1984); Morrison *et al* (1985).
Source: Paulo de Tarso Zuquim Antas, Jean-Luc Dujardin, Antonio Carlos da Silva Farias, Benedito Vitor Rabelo and Dante Luiz Martins Teixeira.
Criteria for inclusion: 123.

Ilha de Maraca, Piratuba lakes and Campos do Macacoary (4)

Location: 0°30'-2°30'N, 49°53'-51°00'W; between Calcoene and Macapa, coastal Amapa Territory.
Area: c.1,200,000 ha including 850,000 ha of lakes and marshes and 150,000 ha of campos.
Altitude: 0-10m.
Province and type: 8.4.1; 02, 03, 06, 07, 08, 09, 11, 12, 16 & 18.
Site description: Two large low-lying offshore islands, Ilha de Maraca and Ilha Tipioca, with with extensive mangrove swamps, brackish marshes, seasonally flooded savannas and small "islands" of scrubby forest; 300 km of the Amapa coast with extensive intertidal mudflats and mangrove swamps; a vast complex of some 75 fresh to brackish lakes and marshes north of the Rio Araguari, including Lago Piratuba (6,500 ha), Lago Novo (15,000 ha), Lago dos Gansos (2,700 ha) and Lago dos Bagres (2,200 ha); the estuarine system of the Rio Araguari; and the Campos do Macacoary, some 150,000 ha of seasonally flooded grassland and varzea forest. The main period of flooding is from February to June.
Principal vegetation: Mangrove swamps with *Avicennia germinans, Laguncularia racemosa* and *Rhizophora mangle*; lakes and marshes with *Nymphaea rudgeana, Cabomba aquatica, Salvinia auriculata, Azolla* sp, *Nymphoides indica, Habenaria* sp, *Eichhornia crassipes, E. azurea, Pistia stratiotes, Ceratopteris pteroides, Echinodorus paniculatus, Utricularia foliosus, Typha domingensis, Neptunia oleracea, Montrichardia arborescens* and species of Gramineae and Cyperaceae; palm savannas with species of *Echinoa, Panicum, Paspalum* and *Oryza*, and the palm *Mauritia flexuosa.*
Land tenure: Partly state owned and partly privately owned in large ranches; Piratuba Biological Reserve is owned by Amapa Territory, and Maraca-Tipioca Ecological Station is owned by SEMA.
Protection: Ilha de Maraca and Ilha Tipioca are included within the Maraca-Tipioca Ecological Station (70,000 ha) established in 1981; part of the lake system and coastal areas north of the Rio Araguari are included within the Lago Piratuba Biological Reserve (395,000 ha) established in 1980. The Campos do Macacoary are unprotected.
Land use: There is very little human activity in the Biological Reserve and Ecological Station, and the areas are difficult of access. In unprotected areas there is intensive fishing, cattle ranching and hunting, particularly for *Dendrocygna* spp.
Waterfowl: A very rich area for waterfowl, with a similar avifauna to that of the Cabo Orange area (site 3). *Phoenicopterus ruber* is a regular non-breeding visitor; over 100 were observed on Ilha Maraca in 1978. Huge numbers of *Dendrocygna viduata* and *D. autumnalis* occur, and there are large passage and wintering populations of Nearctic shorebirds.
Other fauna: Mammals include *Pteronura brasiliensis, Leo onca, Trichechus inunguis, Hydrochoerus hydrochaeris, Tapirus terrestris* and possibly *Trichechus manatus*; reptiles include *Melanosuchus niger, Caiman crocodilus, Chelonia mydas, Eunectes murinus* and possibly *Dermochelys coriacea.* There is a very rich fish fauna in the lake system.
Threats: Wardening in the reserves is reported to be poor, and there is some poaching. The principal threat in unprotected areas is the expansion of ranching activities, with large projects currently being implemented or in the planning stages. There is excessive hunting in some areas, and wholescale slaughter of moulting *Dendrocygna* spp has been reported.
Research and conservation: Preliminary faunal and floral surveys have been conducted in the reserves, and aerial surveys have been made by Teixeira and Best (1981) and Morrison (1983a). Antonio Carlos da Silva Farias is currently carrying out ecological studies on *Phalacrocorax olivaceus, Anhinga anhinga* and Ardeidae.
References: Novaes (1974 & 1978); Spaans (1975a); MINTER & SEMA (1977); Teixeira & Best (1981); IUCN (1982); Antas (1983); Morrison (1983a).
Source: Paulo de Tarso Zuquim Antas, Antonio Carlos da Silva Farias, David Oren, Benedito Vitor Rabelo and Dante Luiz Martins Teixeira.
Criteria for inclusion: 123.

Eastern Ilha Marajo and Baia de Marajo (5)

Location: 0°10'-1°35'S, 48°22'-49°50'W; the eastern half of Ilha Marajo and adacent bay, Amazon delta, Para.

Area: 1,500,000 ha.
Altitude: 0-5m.
Province and type: 8.6.1; 01, 06, 07, 08, 12 & 16.
Site description: A large sea bay with extensive intertidal mudflats and mangrove fringe; and tidal creeks, mangrove swamps, fresh to brackish lakes, marshes and seasonally flooded grassland on the eastern half of Ilha Marajo. The largest lake is Lago Arari (16,500 ha).
Principal vegetation: Mangrove swamps dominated by *Rhizophora mangle*; seasonally flooded grassland (campos).
Land tenure: Ilha Marajo is mainly privately owned in large ranches.
Protection: None.
Land use: Extensive cattle ranching on Ilha Marajo.
Waterfowl: Little information is available, but the area is known to be very rich in waterfowl, with a large resident population of *Eudocimus ruber*. *Phoenicopterus ruber* is an occasional non-breeding visitor. The area is very important for passage and wintering Nearctic shorebirds, particularly *Catoptrophorus semipalmatus*, *Calidris alba* and *C. fuscicollis*; *Larus atricilla* and *Sterna hirundo* winter in large numbers in the bay.
Other fauna: *Trichechus inunguis* occurs; the turtle *Kinosternon scorpioides*is common, and locally important as a source of food.
Threats: Pollution from the city and port of Belem affects the bay, and there is overexploitation of the coastal mangroves.
Research and conservation: Some ornithological surveys have been conducted, but the area remains poorly known.
References: Teixeira & Best (1981).
Source: Paulo de Tarso Zuquim Antas.
Criteria for inclusion: 123.

The Para and west Maranhao coast (6)

Location: 0°32'-2°25'S, 44°30'-48°00'W; from Muraja on Baia de Marajo east for 450 km to Guimaraes and Baia do Cuma, Para and Maranhao.
Area: c.1,000,000 ha.
Altitude: 0-10m.
Province and type: 8.6.1/8.29.10; 01, 02, 03, 05, 06, 07, 08, 09 & 11.
Site description: An extremely indented coastline with over 35 major inlets and estuaries fringed with mangrove swamps and separated by headlands with white sand beaches and coastal sand dunes. The larger bays include Baia de Maracana, Baia de Gurupi, Baia de Turiacu and Baia do Cuma. There are numerous low-lying offshore islands, including the large islands of Maiau and Mangunca in the east; inland there are fresh to brackish lagoons and marshes, riverine marshes, areas of seasonally flooded grassland, palm groves and patches of forest. Tidal variation is up to 8m.
Principal vegetation: Mangrove swamps dominated by *Avicennia germinans* and *Rhizophora mangle*; sandy areas with *Chrysobalanus icaco, Bulbostylis capillaris* and *Ipomoea pescaprae.*
Land tenure: Mainly privately owned.
Protection: None.
Land use: Fishing, a little agriculture, and cutting of mangroves; recreation in the few readily accessible areas. Much of the coast is remote and almost undisturbed.
Waterfowl: An important area for breeding waterfowl including *Phalacrocorax olivaceus*, many Ardeidae, *Eudocimus ruber, Aramides mangle, Eurypyga helias* and *Rynchops niger*; and a very important area for passage and wintering Nearctic shorebirds. During an aerial survey of the western part in January 1982, over 27,000 shorebirds were counted, including 15,500 small *Calidris* sandpipers and significant numbers of *Numenius phaeopus, Tringa* spp, *Catoptrophorus semipalmatus*, and *Calidris alba.* Other common species include *Pluvialis squatarola, Charadrius semipalmatus, C. wilsonius, Actitis macularia, Arenaria interpres* and *Limnodromus griseus. Larus atricilla* and *Sterna hirundo* are also common winter visitors.
Other fauna: *Trichechus manatus* formerly occurred throughout the region, but is now probably extinct in most areas. Many of the beaches are important for nesting sea turtles, and the

estuaries are a very important nursery ground for commercially important shrimp and fish populations.

Threats: Mangroves are being destroyed in some areas, and there is considerable disturbance from tourist development in the Salgado region, between Marapanim and Salinopolis.

Research and conservation: F. C. Novaes and colleagues of the Goeldi Museum in Belem have conducted ornithological surveys and banded waterfowl on the Para coast, and Morrison (1983a) carried out an aerial census of shorebirds in 1982.

References: Novaes (1981); Antas (1983); Morrison (1983a).

Source: Paulo de Tarso Zuquim Antas, Fernando C. Novaes and Paul Roth.

Criteria for inclusion: 123.

Baia de Sao Marcos and the Rio Mearim Estuary (7)

Location: 2°22'-4°17'S, 44°10'-45°28'W; west and south of Sao Luis to the region of Bacabal, Maranhao.

Area: Over 1,000,000 ha.

Altitude: 0-15m.

Province and type: 8.29.10; 02, 06, 07, 08, 09, 11, 12, 16 & 17.

Site description: The vast estuarine system of the Rio Mearim, Rio Pindare, Rio Grajau and many smaller rivers, with several large islands, very extensive seasonally inundated fresh to brackish marshes, and about 80 freshwater lakes of several hundred to 6,000 ha in extent and up to 10m deep, draining into Baia de Sao Marcos. There are extensive mangrove swamps and intertidal mudflats around the bay.

Principal vegetation: Mangrove swamps; coastal marshes with species of *Fimbristylis, Cyperus, Dichromena, Panicum* and various grasses and sedges covered at the highest tides; freshwater marshes; and gallery forest along the rivers.

Land tenure: No information.

Protection: None.

Land use: Cattle ranching, agriculture and illegal commercial hunting of waterfowl; there are important fish and shrimp industries in the bay.

Waterfowl: A very rich area for both breeding waterfowl and passage and wintering Nearctic shorebirds. Resident species include *Tigrisoma lineatum, Egretta caerulea, E. thula, E. alba, Ardea cocoi, Mycteria americana, Jacana jacana, Porphyrula martinica, Vanellus chilensis, Charadrius collaris, Larus cirrocephalus, Phaetusa simplex* and *Sterna superciliaris.* The commoner Nearctic shorebirds include *Pluvialis squatarola, Charadrius semipalmatus, C. wilsonius, Numenius phaeopus*, three species of *Tringa, Catoptrophorus semipalmatus, Actitis macularia, Arenaria interpres, Limnodromus griseus, Calidris alba* and *C. pusilla. Sarkidiornis melanotos* and *Gelochelidon nilotica* have been recorded.

Other fauna: There is thought to be a sizeable population of *Trichechus manatus* in the estuary, and the area is of great importance as a nursery ground for commercially important fishes and shrimps.

Threats: Wetlands are being drained for pastureland and rice cultivation; there is considerable pollution in the bay from the city of Sao Luis; and despite a ban on hunting in 1978, commercial hunting of waterfowl, particularly *Porphyrula martinica*, continues, possibly at a higher level than ever before.

Research and conservation: Domning (1981) has proposed the establishment of a manatee reserve.

References: Aguirre (1962); Domning (1981); Antas (1983).

Source: Paul Roth and references.

Criteria for inclusion: 123.

Baia do Tubarao (8)

Location: 2°15'-2°37'S, 43°20'-43°55'W; 70 km east of Sao Luis, Maranhao.

Area: 130,000 ha.

Altitude: 0-5m.

Province and type: 8.29.10; 01, 03, 05, 06, 07 & 08.
Site description: A large sea bay fed by several small rivers, and with numerous large low-lying islands including Ilha de Santana, Ilha Carrapatal and Ilha Mucunambiba. Wetland habitats include intertidal mudflats, sandy beaches and mangrove swamps; the tidal rise and fall is up to 8m.
Principal vegetation: Mangrove swamps dominated by *Rhizophora mangle.*
Land tenure: The part within the National Park is owned by the Navy and Federal Government; the ownership of the remainder is unknown.
Protection: The eastern part of the area is included within the Lencois Maranhenses National Park (155,000 ha) established in 1981.
Land use: Fishing and recreation.
Waterfowl: *Eudocimus ruber* formerly nested in the mangroves. The area is very important for passage and wintering shorebirds and Laridae, particularly *Pluvialis squatarola, Numenius phaeopus, Catoptrophorus semipalmatus, Arenaria interpres, Calidris canutus, C. alba, C. pusilla, C. minutilla, Larus cirrocephalus* and *Sterna* spp.
Other fauna: Sea turtles occur along the coast.
Threats: Pollution from the city of Sao Luis; destruction of mangroves for fuel and timber; and development for recreation.
References: IUCN (1982).
Source: Paul Roth.
Criteria for inclusion: 3a.

Rio Parnaiba Delta (9)

Location: 2°45'S, 41°45'W; between Tutoia and Parnaiba, Maranhao and Piaui.
Area: 145,000 ha.
Altitude: 0-5m.
Province and type: 8.29.10; 02, 03, 05, 06, 07, 08 & 12.
Site description: The estuarine and delta system of the Rio Parnaiba, with extensive fresh to brackish lakes and marshes, sandy beaches, coastal sand dunes, mangrove swamps, intertidal mudflats and numerous low-lying islands. The tidal rise and fall is up to 8m.
Principal vegetation: Mangrove swamps dominated by *Rhizophora mangle.*
Land tenure: Privately owned.
Protection: None.
Land use: Fishing and recreation; ranching and agriculture in surrounding areas.
Waterfowl: *Eudocimus ruber* occurs as a non-breeding visitor at the eastern limit of its present distribution in Brazil. The area is very important for passage and wintering Nearctic shorebirds, and for wintering *Sterna* spp.
Other fauna: *Trichechus manatus* and *Caiman latirostris* are known to occur.
Threats: Drainage of the marshes for agriculture, and destruction of mangroves for fuel and timber.
Source: Paulo de Tarso Zuquim Antas and Paul Roth.
Criteria for inclusion: 2a & 3a.

Rio Jaguaribe lakes and marshes (10)

Location: 4°15'-5°30'S, 37°45'-38°30'W; 130 km southeast of Fortaleza, Ceara.
Area: 80,000 ha, including 60,000 ha of riverine and coastal marshes and 20,000 ha of lakes.
Altitude: 0-100m.
Province and type: 8.20.4; 02, 05, 06, 07, 08, 09, 11, 12, 16 & 17.
Site description: The estuarine system and lower 160 km of the Rio Jaguaribe, with extensive riverine marshes, over 80 small lakes and dams on the surrounding plains, large areas of seasonally inundated grassland and arable land, a chain of small brackish coastal lagoons and marshes, coastal sand dunes, sandy beaches, mangrove swamps and intertidal mudflats. There is also a complex of salt pans near the coast.
Principal vegetation: No information.

Land tenure: Mainly private ownership.
Protection: None.
Land use: Fishing; agriculture; cattle ranching; and illegal hunting.
Waterfowl: Little information is available, but the area is known to be important for passage and wintering shorebirds and Laridae. *Dendrocygna viduata* is common, and *Netta erythrophthalma erythrophthalma* has been observed on the coastal lagoons.
Other fauna: No information.
Threats: Illegal commercial hunting of waterfowl, mainly *Dendrocygna viduata*; pollution from the town of Aracati; drainage of the marshes for agriculture; and development for recreation.
Research and conservation: Biologists from IBDF, two local universities and the Canadian Wildlife Service have banded shorebirds in the estuary.
Source: Susana de Moura Lara-Resende and Dante Luiz Martins Teixeira.
Criteria for inclusion: 3a.

Areia Branca and Macau coastal marshes and salt pans (11)

Location: 4°55'-5°15'S, 36°10'-37°15'W; on the coast between Areia Branca and Sao Bento do Norte, Rio Grande do Norte.
Area: 70,000 ha (Areia Branca 27,500 ha, Macau and Sao Bento do Norte 42,500 ha).
Altitude: 0-5m.
Province and type: 8.20.4; 02, 05, 06, 07 & 08.
Site description: 115 km of sea coast and several small estuaries, with sandy beaches, intertidal mudflats, mangrove swamps, sand dunes, brackish coastal lagoons and marshes, and large areas of salt pans, particularly around Areia Branca and Macau.
Principal vegetation: No information.
Land tenure: No information.
Protection: None.
Land use: Salt extraction.
Waterfowl: Little information available, but known to be important for passage and wintering shorebirds and Laridae.
Other fauna: No information.
Threats: No information.
Source: Susana de Moura Lara-Resende and Dante Luiz Martins Teixeira.
Criteria for inclusion: 0.

Coastal marshes near Natal (12)

Location: 5°15'-6°22'S, 35°00'-35°30'W; the coast between Touros and Canguaretama, north and south of Natal, Rio Grande do Norte.
Area: 43,500 ha, including 33,500 ha of estuaries and marshes, and 10,000 ha of lakes.
Altitude: 0-10m.
Province and type: 8.20.4; 02, 05, 06, 07, 08 & 12.
Site description: 140 km of sea coast, several small estuaries, and a chain of some 40 small lakes on the coastal plain at the extreme northeastern tip of Brazil; with sand beaches, intertidal mudflats, mangrove swamps, and fresh to brackish lakes and marshes. There is a belt of coral reefs about 2 km offshore.
Principal vegetation: Mangroves dominated by *Rhizophora mangle*.
Land tenure: Mainly private ownership.
Protection: None.
Land use: Fishing; agriculture; cultivation of coconuts; and recreation along the coast.
Waterfowl: Little information available, but known to be important for passage and wintering Nearctic shorebirds.
Other fauna: An important area for *Trichechus manatus*.

Threats: Excessive exploitation of mangroves; overfishing; pollution from Natal city; tourist development; and drainage for agriculture.
Source: Paulo de Tarso Zuquim Antas and Dante Luiz Martins Teixeira.
Criteria for inclusion: 2a & 3a.

The Mamanguape Estuary (13)

Location: 6°46'S, 34°57'W; 40 km north of Joao Pessoa, Paraiba.
Area: 3,000 ha.
Altitude: 0m.
Province and type: 8.20.4; 02, 05, 06, 07 & 08.
Site description: The estuary of the Rio Mamanguape, with fringing mangrove swamps, sandy beaches, intertidal mudflats, and some brackish marshes.
Principal vegetation: No information.
Land tenure: State owned.
Protection: Within the recently established Mamanguape Ecological Station (3,000 ha).
Land use: Fishing and recreation.
Waterfowl: Little information available but known to be important for migratory shorebirds.
Other fauna: An important area for *Trichechus manatus*.
Threats: Disturbance from recreation activities; the Ecological Station has no wardens.
Source: Paulo de Tarso Zuquim Antas.
Criteria for inclusion: 2a & 3a.

Ilha de Itamaraca and the Rio Goiana Estuary (14)

Location: 7°30'-7°50'S, 34°48'-34°55'W; 30-70 km north of Recife, Pernambuco.
Area: 25,000 ha.
Altitude: 0-5m.
Province and type: 8.20.4/8.7.1; 02, 03, 05, 06 & 08.
Site description: A large low-lying island with extensive mangrove swamps and ocean beaches; and the estuary of the Rio Goiana with mangrove swamps and intertidal mudflats.
Principal vegetation: No information.
Land tenure: Private ownership.
Protection: None.
Land use: Fishing; exploitation of mangroves; recreation; and farming on Ilha de Itamaraca.
Waterfowl: Little information available, but the area is known to be important for migratory shorebirds, and *Egretta caerulea* occurs.
Other fauna: An important area for *Trichechus manatus*.
Threats: Destruction of mangroves; the use of chemicals to eliminate snails in a programme of disease control; and pesticide runoff from adjacent sugar cane plantations. The island suffers heavy disturbance from tourist recreation.
Source: Paulo de Tarso Zuquim Antas.
Criteria for inclusion: 2a & 3a.

Maceio Lagoons and Praia do Peba (15)

Location: 9°35'-10°10'S, 35°45'-36°15'W; from Maceio southwest along the coast for 70 km, Alagoas.
Area: 19,000 ha.
Altitude: 0-15m.
Province and type: 8.7.1; 02, 05, 06, 07, 08 & 12.
Site description: 110 km of sea coast with long sandy beaches, intertidal sandflats, sand dunes and offshore reefs; several small estuaries with mangrove swamps; and a chain of brackish coastal lagoons and marshes.

Principal vegetation: No information.
Land tenure: Mainly private ownership; the Ecological Station is state owned.
Protection: 3,000 ha of sandy beach and sand dunes in the south are included within the Praia do Peba Ecological Station, established to protect turtle nesting beaches.
Land use: Fishing.
Waterfowl: Little information available, but known to be important for migratory shorebirds, and *Netta erythrophthalma erythrophthalma* has been recorded on the lagoons.
Other fauna: Praia do Peba is an important nesting beach for the sea turtles *Chelonia mydas* and *Caretta caretta*; *Lepidochelys olivacea* may nest.
Threats: There is some threat of oil pollution along the sea beaches.
Source: Paulo de Tarso Zuquim Antas.
Criteria for inclusion: 2a & 3a.

The Sergipe coast (16)

Location: 10°45'-11°55'S, 37°00'-37°38'W; from the Aracaju area SSW along the coast to the Conde area, Sergipe and extreme northeastern Bahia.
Area: 95,500 ha.
Altitude: 0-10m.
Province and type: 8.7.1; 02, 05, 06, 07 & 08.
Site description: 140 km of coastline with ocean beaches, and coastal sand dunes; and four large estuarine systems with extensive brackish lagoons and marshes, intertidal mudflats and mangrove swamps. The principal rivers are the Rio Sergipe, Rio Vaza-Barris, Rio Piaui, Rio Real and Rio Itapicuru. The area includes the very extensive Barra de Estancia marshes, and the Praia de Pirambu (beach).
Principal vegetation: Mangrove swamps and brackish marshes.
Land tenure: Private ownership.
Protection: No habitat protection; Praia de Pirambu is protected during the turtle nesting season.
Land use: Fishing; exploitation of mangroves; and tourist recreation.
Waterfowl: Little information is available, but the area is known to be important for migratory shorebirds.
Other fauna: The estuaries are important for *Trichechus manatus*; and Praia de Pirambu is an important nesting beach for *Chelonia mydas*, *Caretta caretta* and *Lepidochelys olivacea*.
Threats: Destruction of mangroves; excessive disturbance from tourist recreation; pollution from pesticide runoff; and oil exploration at Barra de Estancia.
Source: Paulo de Tarso Zuquim Antas.
Criteria for inclusion: 2a & 3a.

Baia de Todos os Santos and central Bahia coast (17)

Location: 12°35'-14°10'S, 38°25'-39°10'W; from the Salvador area south to the Camamu area, Bahia.
Area: 180,000 ha.
Altitude: 0-15m.
Province and type: 8.7.1; 01, 02, 03, 05, 06, 07 & 08.
Site description: Baia de Todos os Santos is a large sea bay containing the estuary of the Rio Paraguacu, and with a narrow connection to the sea; there are extensive tidal mudflats and fringing mangrove swamps. To the south there is a chain of small estuaries and large low-lying islands, with tidal mudflats, mangrove swamps, brackish coastal lagoons and marshes, and ocean beaches, extending 150 km to the region of Camamu.
Principal vegetation: Mangrove swamps dominated by *Rhizophora mangle*.
Land tenure: Mainly private ownership.
Protection: None.
Land use: The city of Salvador with its large industrial centre lies on Baia de Todos os Santos; elsewhere there is fishing, exploitation of mangroves, tourist recreation, and oil exploration.

Waterfowl: Little information is available. A variety of Ardeidae has been recorded, and the coastal mudflats constitute a major wintering area for Nearctic shorebirds, particularly *Pluvialis squatarola, Numenius phaeopus, Catoptrophorus semipalmatus, Calidris pusilla* and *C. minutilla.*
Other fauna: No information.
Threats: There is a considerable amount of pollution from the city of Salvador and oil exploration activities.
References: Antas (1983).
Source: Paulo de Tarso Zuquim Antas.
Criteria for inclusion: 0.

The Rio Pardo and Rio Jequitinhonha Estuaries (18)

Location: 15°40'-15°50'S, 38°52'-39°00'W; near Canavieiras and Belmonte, Bahia.
Area: 6,000 ha.
Altitude: 0m.
Province and type: 8.7.1; 02, 05, 06, 07, 08 & 12.
Site description: The estuarine systems of the Rio Pardo and Rio Jequitinhonha, with extensive mangrove swamps, intertidal mudflats, brackish coastal lagoons and marshes, and adjacent sandy beaches; there are some freshwater lakes and marshes inland.
Principal vegetation: No information.
Land tenure: Private ownership.
Protection: None.
Land use: Fishing and exploitation of mangroves.
Waterfowl: Little information is available. The area is known to be important for passage and wintering shorebirds and Laridae, particularly *Numenius phaeopus* and *Sterna hirundo*, and *Netta erythrophthalma erythrophthalma* has been recorded on the lagoons behind the beach.
Other fauna: No information.
Threats: No information.
Source: Paulo de Tarso Zuquim Antas.
Criteria for inclusion: 0.

Wetlands in Brasilia National Park (19)

Location: 15°40'S, 47°50'W; 10 km west of Brasilia, Distrito Federal.
Area: c.1,000 ha of wetlands.
Altitude: 1,350m.
Province and type: 8.30.10; 10, 13 & 15.
Site description: The Santa Maria Dam, a dam of 625 ha constructed in 1970, with a widely fluctuating water level, muddy margins, and aquatic vegetation restricted to the mouths of streams entering the dam; and numerous springs, streams and associated freshwater marshes on an undulating plateau. There is a well marked rainy season from October to April.
Principal vegetation: In a region of upland savanna and cerrado, with stands of *Mauritia flexuosa* and gallery forest along the water courses.
Land tenure: Owned by IBDF.
Protection: Included within Brasilia National Park (28,000 ha) established in 1961.
Land use: Scientific research and tourism in the National Park; the Santa Maria Dam is a water supply for the nearby city of Brasilia.
Waterfowl: Over 40 species of waterfowl have been recorded, but most occur only in small numbers, and many only as occasional visitors. Breeding species include *Podilymbus podiceps, Amazonetta brasiliensis* and a variety of Rallidae including the rare *Laterallus xenopterus* and *Micropygia schomburgkii.* Common visitors include *Phalacrocorax olivaceus, Dendrocygna viduata* and *D. autumnalis.* In recent years, *Netta erythrophthalma erythrophthalma* has become

a regular visitor; 100-150 were observed in August and September 1980, and smaller numbers again in 1981 and 1983.

Other fauna: The Park is one of the few known localities of the Brasilia Tapaculo *Scytalopus novacapitalis* which occurs in dense riverine thickets and gallery forest. Mammals in the Park include *Chrysocyon brachyurus* and *Ozotoceros bezoarticus*.

Threats: None; the National Park is well protected.

Research and conservation: A considerable amount of research has been conducted on the fauna and flora of the National Park.

References: IUCN (1982); Antas & Lara-Resende (1983a); Negret & Teixeira (1984).

Source: See references.

Criteria for inclusion: 2a & 3a.

The floodplain of the Rio Araguaia and Ilha do Bananal (20)

Location: 9°15'-15°30'S, 49°35'-51°55'W; the middle Rio Araguaia, from Araguaia in the south 750 km downstream to Barreira do Campo, Goias and Mato Grosso.

Area: c.3,800,000 ha of wetlands in a total area of 5,435,000 ha.

Altitude: 180-240m.

Province and type: 8.30.10; 09, 11, 12, 16 & 18.

Site description: The vast floodplain and lacustrine system of the middle Rio Araguaia, Rio Formosa and Rio das Mortes, including Ilha do Bananal between the Rio Araguaia and Rio Formosa. Ilha do Bananal, with an area of about 2,000,000 ha, is the largest fluvial island in the world. The whole system stretches for 750 km and is up to 100 km wide. During the period of flooding, from December to mid June, large areas of grassland, palm savanna and forest are inundated in vast shallow lakes; during the dry season, extensive sand banks and muddy areas are exposed. There are many permanent lakes with surrounding marshes, the largest of which is about 4,500 ha.

Principal vegetation: In the transition zone between the humid tropical forest of the Amazon Basin and woody savannas (cerrados) of central Brazil, with gallery forest along the main water courses.

Land tenure: Ilha do Bananal is owned by the Federal Government; the remainder is privately owned.

Protection: The northern part of Ilha do Bananal is included within the Araguaia National Park (562,312 ha) established in 1959; the northeastern portion of the floodplain is included within the Coco-Javaes Ecological Station (37,000 ha); and the southern part of Ilha do Bananal is in an Indian Reservation.

Land use: Extensive cattle ranching; fishing; and illegal hunting.

Waterfowl: An extremely rich area for waterfowl, with a wide variety of resident breeding species, and many Nearctic shorebirds occurring on migration. Resident species include *Phalacrocorax olivaceus, Anhinga anhinga, Ixobrychus exilis, Tigrisoma lineatum, Nycticorax nycticorax, Nyctanassa violacea, Pilherodius pileatus, Cochlearius cochlearius*, all three Ciconiidae, *Theristicus caudatus, Ajaia ajaja, Anhima cornuta*, all three *Dendrocygna* spp, *Amazonetta brasiliensis, Sarkidiornis melanotos, Cairina moschata, Opisthocomus hoazin, Porphyrula martinica, Eurypyga helias, Jacana jacana* and *Vanellus chilensis*. There are large breeding colonies of Ardeidae, *Ajaia ajaja* and *Mycteria americana*.

Other fauna: Mammals include *Chrysocyon brachyurus, Pteronura brasiliensis, Lutra enudris, Leo onca, Tapirus terrestris, Hydrochoerus hydrochaeris, Blastocerus dichotomus, Ozotoceros bezoarticus* and *Inia geoffrensis*. Reptiles include *Melanosuchus niger, Caiman crocodilus, Podocnemis expansa* and *Eunectes murinus*. Fishes include *Arapaima gigas, Cichla* spp, *Salminus hilarii, Serrasalmus* spp, *Electrophorus eletricus*, various Pimelodidae, and many others.

Threats: Wardening in the National Park is reported to be poor; a major highway is being constructed through the Park; illegal grazing of domestic livestock and poaching occur; and there is some illegal settlement. Outside the protected areas there is overgrazing by domestic livestock, drainage of wetlands for rice cultivation, modifications in the water courses for irrigation purposes, and pollution from pesticide runoff. There are reports of the use of pesticides to kill *Dendrocygna* spp along the Rio Formosa, to reduce the numbers feeding in rice fields.

Research and conservation: Preliminary faunal and floral surveys have been conducted in the National Park and Ecological Station, and a detailed management plan has been prepared for the Park.
References: IBDF & FBCN (1981b); IUCN (1982); Antas (1983).
Source: Paulo de Tarso Zuquim Antas and Susana de Moura Lara-Resende.
Criteria for inclusion: 123.

The upper Rio Xingu (21)

Location: 10°05'-12°55'S, 51°55'-54°15'W; in northeastern Mato Grosso.
Area: 850,000 ha.
Altitude: 250-275m.
Province and type: 8.30.10; 09, 11, 12, 16 & 18.
Site description: Extensive tracts of riverine marshes, associated lakes, seasonally indundated grassland and swamp forest along the upper Rio Xingu and its tributaries including the Rio Suia-Micu, Rio Culuene, Rio Ronuro and Rio Steinen. Flooding occurs between October and April.
Principal vegetation: No information.
Land tenure: An Indian Reservation, owned by the Federal Government.
Protection: The area is afforded some protection by the local Indians.
Land use: Traditional activities of the local Indians.
Waterfowl: Very little information available; known to be an important area for both resident waterfowl and migratory shorebirds.
Other fauna: *Blastocerus dichotomus, Trichechus inunguis, Melanosuchus niger* and *Podocnemis expansa* are known to occur.
Threats: There is an increase in ranching and agriculture in the surrounding areas, and the Indians themselves are adopting modern farming practices.
Research and conservation: One of the most important and least disturbed wetland areas in central Brazil; identified as a priority area for conservation by Wetterberg *et al* (1976).
References: Wetterberg *et al* (1976).
Source: Paulo de Tarso Zuquim Antas and Susana de Moura Lara-Resende.
Criteria for inclusion: 123.

The Rio Guapore and Rio Cautario marshes (22)

Location: 12°00'S, 64°50'W to 15°10'S, 59°30'W; along the Bolivian border from Mato Grosso to the region of Principe da Beira, Mato Grosso and Rondonia.
Area: 1,400,000 ha.
Altitude: 150-230m.
Province and type: 8.6.1/8.30.10; 09, 11, 12, 16 & 18.
Site description: Extensive freshwater marshes and swamps along the Rio Guapore from its headwaters near the town of Mato Grosso 700 km downstream along the Bolivian border to near its confluence with the Rio Mamore; and swamps and riverine marshes along the lower Rio Cautario to its confluence with the Guapore. There are large tracts of seasonally flooded gallery forest and humid palm savanna with "islands" of forest. The dry season is from May to September. This wetland is contiguous with the Bolivian site 23.
Principal vegetation: No information.
Land tenure: Mainly private ownership; the Biological Reserve is owned by the Federal Government.
Protection: The western part is included in the Alto Guapore Biological Reserve (600,000 ha) established in 1982; the southeastern part is included in the recently established Alto Guapore Ecological Station.
Land use: Some hunting, fishing, cattle ranching and agriculture, but much of the area remains almost undisturbed.

Waterfowl: Very little information available, but known to be very rich in breeding waterfowl, and important for Nearctic shorebirds on migration. Species recorded include *Pluvialis dominica, Limosa haemastica, Calidris melanotos, Micropalama himantopus* and *Steganopus tricolor.*
Other fauna: *Blastocerus dichotomus, Melanosuchus niger, Caiman crocodilus* and *Podocnemis expansa* are known to occur.
Threats: Ranching activities are being expanded in the area, and there is a considerable amount of illegal hunting, particularly of crocodilians. There are some small farms in the Biological Reserve.
References: Antas (1983).
Source: Paulo de Tarso Zuquim Antas.
Criteria for inclusion: 123.

Pantanal do Mato Grosso (23)

Location: 15°30'-21°30'S, 55°00'-59°00'W; northwestern Mato Grosso do Sul and southern Mato Grosso, on the Bolivian and Paraguayan borders.
Area: 11,000,000 ha of wetlands in a total region of 15,000,000 ha.
Altitude: 80-150m; (isolated peaks southeast of Corumba to 1,065m).
Province and type: 8.30.10; 09, 11, 12, 13, 16 & 18.
Site description: A vast region of seasonally flooded savannas in the upper drainage of the Rio Paraguay and tributaries; with many slow-flowing, meandering rivers and streams, numerous small permanent freshwater lakes and marshes, areas of higher dry savannna, and belts and islands of xerophytic scrub (matorral) and humid deciduous forest. The region is bounded by the Serra dos Coroados ou S. Lourenco to the north, the Planalto de Mato Grosso to the east, and the Serra da Bodoquena and Serra de Maracaju to the south. The wetlands drain west, through a gap 50 km wide between the Corumba and Ladario hills and the Serra da Bodoquena. The natural drainage is very slow, rivers falling by as little as 3 cm per km, and the soils are poor and badly aerated. The annual rainfall is 1,200-1,400 mm, 80% of which falls between December and March. The main flooding occurs from the end of December to mid June. There are great seasonal fluctuations in the extent of flooding. The largest permanent wetlands, including lakes up to 10,000 ha in extent, are in the northwest on the Bolivian border. Although the greater part of the Pantanal lies in Brazil, 1,235,000 ha along the western edge lie in Bolivia, and 400,000 ha in the south lie in northern Paraguay (see Bolivia sites 19 and 20, and Paraguay site 1).
Principal vegetation: Vast tracts of seasonally inundated savanna with scattered palms *Copernica australis*; patches of humid deciduous forest and gallery forest with species of *Jacaranda, Caryocar, Vochysia* and *Tecoma*; and marshes with species of *Eichhornia, Azolla, Pistia* and Cyperaceae.
Land tenure: Mainly privately owned in large ranches. The Ecological Station is owned by SEMA.
Protection: 137,000 ha are protected in the Pantanal Matogrossense National Park, established in 1981, and 12,000 ha in Taiama Ecological Station, also established in 1981. The remainder of the area is unprotected.
Land use: The principal activity throughout the region is cattle ranching, which was introduced at the end of the 19th century. The region supports an important fishery, and there is a considerable amount of illegal hunting of crocodilians and fur-bearers for their hides, and live animals for the zoo and pet trade. There is a little agriculture, industry and mining, and in recent years some nature tourism.

Waterfowl: Probably the most important wetland area in South America in terms of waterfowl populations, with huge resident breeding populations of a wide variety of species typical of open freshwater marshes and wet savanna. Characteristic species include *Phalacrocorax olivaceus, Anhinga anhinga, Tigrisoma lineatum, Pilherodius pileatus, Syrigma sibilatrix, Bubulcus ibis, Butorides striatus, Egretta thula, E. alba, Ardea cocoi, Mycteria americana, Euxenura maguari, Jabiru mycteria, Harpiprion caerulescens, Theristicus caudatus, Phimosus infuscatus, Ajaia ajaja, Chauna torquata, Dendrocygna viduata, D. autumnalis, Amazonetta brasiliensis, Sarkidiornis melanotos, Cairina moschata, Aramus guarauna*, a wide variety of Rallidae, *Jacana jacana, Vanellus chilensis, Himantopus himantopus, Phaetusa simplex* and *Sterna superciliaris*. The Pantanal is also very important for Nearctic shorebirds, particularly on passage to and from wintering areas further south. The commoner species are *Pluvialis dominica, Bartramia longicauda, Tringa* spp, *Calidris fuscicollis, C. melanotos* and *Tryngites subruficollis*.

Other fauna: The region is rich in birds of prey including *Cathartes burrovianus, Rostrhamus sociabilis, Circus buffoni, Buteogallus urubitinga, Busarellus nigricollis* and *Polyborus plancus*. Mammals include *Pteronura brasiliensis, Hydrochoerus hydrochaeris* and *Blastocerus dichotomus*. Reptiles include *Caiman crocodilus yacare* and *C. latirostris*.

Threats: Large tracts of the Pantanal remain remote and only slightly modified by man. However, there has recently been a great acceleration in development, and in many areas wetlands are threatened. The principal threats are: watershed deforestation resulting in increased turbidity and increased siltation rates; modifications to water courses and construction of dams and canals for irrigation projects; construction of hydroelectric dams; expansion of agriculture; introduction of domestic buffalo; pollution of rivers from industries, mines and pesticide runoff; increase in mining activities; overfishing; and extensive illegal hunting, particularly of *Caiman crocodilus* and Anatidae. The alcohol industry is being developed along the Rio Cuiaba, and is likely to cause serious pollution in that river in the future.

Research and conservation: In recent years, a considerable amount of attention has been focused on the Pantanal, and a variety of faunal and floral investigations and bird banding programmes have been conducted or are in progress. The Instituto de Preservacao e Controle Ambiental in Mato Grosso do Sul has been particularly active in this regard. The region has tremendous potential for nature tourism, recreation and sport hunting, and there is a great need to establish a rational and integrated management plan for the entire area. It is essential that additional areas be protected; attempts are being made to enlarge the National Park to over 200,000 ha, but ideally a protected area should cover a complete watershed as a corridor, in order to ensure the survival of the complete spectrum of natural processes, ecosystems and species.

References: Hueck (1978); Dourojeanni (1980); Mercedes-Benz do Brasil S.A. (1980); IUCN (1982).

Source: Marlise Becker, Carlos Yamashita and references.

Criteria for inclusion: 123.

Floodplain of the Rio Parana (24)

Location: 21°00'S, 51°45'W to 24°10'S, 54°25'W; between Tres Lagoas and the Paraguayan border, Sao Paulo, Parana and Mato Grosso do Sul.

Area: Formerly c.625,000 ha.

Altitude: 240-265m.

Province and type: 8.8.2; 09, 11, 16 & 18.

Site description: The extensive floodplain of the 440 km stretch of the Rio Parana downstream from Tres Lagoas, formerly 10-20 km wide, but now much reduced following the construction of huge hydroelectric dams on the Paranaiba (upper Parana) above Tres Lagoas.

Principal vegetation: No information.

Land tenure: No information.

Protection: None.

Land use: No information.

Waterfowl: No information.

Other fauna: No information.

Threats: The Itaipu Hydroelectric Dam 60 km downstream on the Rio Parana, on the Brazil/Paraguay border, has flooded 146,000 ha of the valley and extends back to the lower portion of the present site.
Criteria for inclusion: 0.

Wetlands in Serra da Canastra National Park (25)

Location: 20°15'S, 46°40'W; 50 km north of Passos, Minas Gerais.
Area: Area of wetlands unknown; National Park 73,000 ha.
Altitude: 900-1,400m.
Province and type: 8.8.2; 10 & 13.
Site description: Cold clear highland springs, streams and associated bogs at the headwaters of several large rivers including the Rio Sao Francisco; on a high plateau of rolling grassland with steep escarpments. There are numerous waterfalls, rapids and pools up to 2m deep; water levels remain fairly constant throughout the year except during occasional flash floods in December and January. The annual rainfall is 1,300-1,700 mm.
Principal vegetation: *Sphagnum* bogs; rolling grassland (campos limpios); open woodland (cerrado); and riparian forest.
Land tenure: Owned by IBDF.
Protection: Within the Serra da Canastra National Park (73,000 ha) established in 1972; the protection is excellent.
Land use: Formerly a single large ranch with low density cattle grazing; now undisturbed except for some nature tourism and research activities.
Waterfowl: The larger streams and bogs support small populations of *Podiceps dominicus*, *Theristicus caudatus*, *Gallinago (g) paraguaiae* and *G. undulata*. The area is of major importance for its resident population of the extremely rare *Mergus octosetaceus*. J. M. Dietz estimated the population in the Park and surrounding areas at about 50 birds in 1980. This species is dependent on clear, fast-flowing rivers and streams which have now become extremely rare outside protected areas as a result of watershed degradation and extensive soil erosion.
Other fauna: The Brasilia Tapaculo *Scytalopus novacapitalis* was discovered in riverine thickets in the Park in October 1983; this species was previously thought to occur only in the vicinity of Brasilia. The Park has large populations of a variety of birds typical of tall grassland, a habitat becoming very rare in central Brazil. Mammals include *Chrysocyon brachyurus* and *Ozotoceros bezoarticus*.
Threats: None, other than fires which destroy large areas of grassland each year.
Research and conservation: Dietz (1980) conducted a study on *Chrysocyon brachyurus*, and IBDF has prepared a management plan for the Park. The Park contains one of the few remaining upland grassland areas with clear rivers and streams in central Brazil.
References: Dietz (1980); IUCN (1982).
Source: James M. Dietz, Helmut Sick and Derek A. Scott.
Criteria for inclusion: 2a, 2b & 3a.

Ninhal do Barreiro (26)

Location: 20°05'S, 45°38'W; 45 km NNW of Formiga, Minas Gerais.
Area: 1,000 ha.
Altitude: 650m.
Province and type: 8.8.2; 09, 12, 16, 17 & 18.
Site description: A complex of slow-flowing rivers, marshes, freshwater lakes, and seasonally flooded grassland, arable land and patches of forest; in the upper basin of the Rio Sao Francisco.
Principal vegetation: In a region of campos and cerrado.
Land tenure: Privately owned.
Protection: No legal protection, but the owners afford the area some protection and restrict hunting.

Land use: Cattle ranching, and some illegal hunting.
Waterfowl: A very important breeding area for waterfowl of the upper Rio Sao Francisco, with large colonies of *Egretta alba, Ardea cocoi* and *Ajaia ajaja.* Other resident species include *Nycticorax nycticorax, Bubulcus ibis, Egretta thula* and *Jabiru mycteria.* Many other species of waterfowl occur on migration.
Other fauna: *Chrysocyon brachyurus* and *Caiman latirostris* occur.
Threats: Illegal hunting poses the only threat at present.
Research and conservation: M. A. de Andrade is currently conducting a study of the avifauna, and banding nesting birds.
Source: Marco Antonio de Andrade.
Criteria for inclusion: 2c & 3a.

The Rio Doce Estuary, Juparana lakes and Linhares marshes (27)

Location: 18°35'-19°45'S, 39°41'-40°25'W; between Linhares and Sao Mateus, Espirito Santo.
Area: 191,500 ha (180,000 ha of coastal marshes; 11,500 ha of inland lakes).
Altitude: 0-30m.
Province and type: 8.8.2; 02, 05, 07, 08, 09, 12 & 18.
Site description: The estuarine system of the Rio Doce and 140 km of coastal marshes from Conceicao da Barra in the north to 30 km south of the Rio Doce in the south; with mangrove swamps, ocean beaches, fresh to brackish lakes and marshes, and areas of swamp forest; also inland a series of eight freshwater lakes with some fringing marshes in rolling hill country, the largest being Lagoa Juparana (5,500 ha).
Principal vegetation: In the humid tropical forest zone, although most of the forest has now been cleared for ranching and agriculture. The 44,000 ha of Atlantic forest protected in Sooretama Biological Reserve and Reserva Florestal de Linhares (contiguous reserves) represent almost 50% of the primary forest remaining in the State of Espirito Santo.
Land tenure: Mainly privately owned; Sooretama Biological Reserve is owned by IBDF, the Reserva Florestal de Linhares is owned by Companhia Vale do Rio Doce, and the beaches at the mouth of the Rio Doce are owned by Espirito Santo State.
Protection: Some freshwater lakes, swamps and swamp forest are included in the Sooretama Biological Reserve (24,000 ha) established in 1943, and in Reserva Florestal de Linhares (20,000 ha); the beaches at the mouth of the Rio Doce (Comboios) are protected by IBDF during the turtle nesting season. The remainder is unprotected.
Land use: Fishing and recreation along the coast; extensive cattle ranching and agriculture in surrounding areas; illegal hunting.
Waterfowl: Resident species include *Podilymbus podiceps, Phalacrocorax olivaceus, Ixobrychus exilis, Tigrisoma lineatum, Nycticorax nycticorax, Pilherodius pileatus, Butorides striatus, Egretta alba, Amazonetta brasiliensis, Cairina moschata, Aramus guarauna, Aramides cajanea, Porphyrula martinica, Jacana jacana* and *Vanellus chilensis.* A number of migrant Nearctic shorebirds occur along the coast, and *Sterna hirundinacea* occurs at the limit of its non-breeding range during the austral winter.
Other fauna: The beaches at the mouth of the Rio Doce are the only known regular nesting site of *Dermochelys coriacea* in Brazil.
Threats: Beach development for recreation and exploration for oil along the coast; and illegal hunting.
Research and conservation: Tundisi (1983a) has conducted limnological studies in the freshwater lakes of the Rio Doce valley. Research at Sooretama Biological Reserve has concentrated on the endangered forest fauna and flora.
References: IUCN (1982); Tundisi (1983a).
Source: Paulo de Tarso Zuquim Antas and Derek A. Scott.
Criteria for inclusion: 2c & 3a.

Lagoa Feia and the Paraiba do Sul marshes (28)

Location: 21°25'-22°10'S, 41°00'-41°35'W; south and east of Campos, Rio de Janeiro.
Area: 68,000 ha.
Altitude: 0-5m.
Province and type: 8.8.2; 02, 05, 07, 08, 09 & 12.
Site description: The estuarine/delta system of the Rio Paraiba do Sul, with extensive mangrove swamps; sandy beaches along the coast; a complex of relatively shallow freshwater lakes and marshes in the delta area; and a chain of small brackish lagoons stretching along the coast to the south. Lagoa Feia in the southern part of the delta is much the largest lake; drainage schemes had reduced its area from 30,000 ha in 1933 to 17,000 in 1978, and eliminated many smaller lakes nearby. The water level in the lake is now controlled and there are only slight seasonal fluctuations.
Principal vegetation: The aquatic vegetation includes Cyperaceae and species of *Eichhornia, Pistia, Eleocharis, Chara, Elodea, Cabomba, Potamogeton, Lemna, Salvinia, Typha, Schoenoplectus* and *Echinochloa.*
Land tenure: Mainly private, with some state ownership.
Protection: No legal protection, but some landowners prohibit hunting.
Land use: Fishing; cattle ranching; cultivation of sugar cane for the alcohol industry; and exploration for oil.
Waterfowl: A very important area for both resident and migratory waterfowl. Resident species include *Podilymbus podiceps, Podiceps dominicus, Phalacrocorax olivaceus, Bubulcus ibis, Butorides striatus, Egretta caerulea, E. thula, E. alba, Ardea cocoi, Dendrocygna bicolor, D. viduata, D. autumnalis, Anas bahamensis, Amazonetta brasiliensis, Oxyura dominica, Aramus guarauna, Rallus nigricans, Porzana flaviventer, Laterallus melanophaius, Porphyriops melanops, Gallinula chloropus, Porphyrula martinica, Jacana jacana, Charadrius collaris* and *Sterna superciliaris. Netta erythrophthalma erythrophthalma* occurs in significant numbers; *Ixobrychus involucris* and *Rallus sanguinolentus* occur at the northern limit of their range in southeastern Brazil; and *Nycticryphes semicollaris* has been recorded as a winter visitor. Common Nearctic migrants include *Charadrius semipalmatus, Tringa melanoleuca, T. flavipes, T. solitaria* and *Actitis macularia*, and *Anas discors* has occurred as a vagrant.
Other fauna: *Lutra* sp, *Hydrochoerus hydrochaeris* and *Caiman latirostris* occur. Sick (1967) describes an interesting case of local speciation in the seed-eater *Sporophila bouvreuil*, which demonstrates the zoogeographic isolation of this wetland. The subspecies confined to the Lagoa Feia swamps differs from other forms of the species in lacking a distinctive male plumage.
Threats: The wetland is under serious threat from continuing drainage for agriculture, particularly the cultivation of sugar cane; land reclamation for urban and industrial development; pollution; disturbance from recreation; intensive illegal hunting; and the deliberate burning of marsh vegetation.
Research and conservation: A variety of faunal and floral investigations have been carried out by the Museu Nacional and Fundacao Estadual de Engenharia do Meio Ambiente (FEEMA).
References: Sick (1962, 1967 & 1968); Schneider & Sick (1962); Coimbra-Filho (1969a); Maciel & Araujo (1979); FEEMA (1980).
Source: Luiz A. Pedreira Gonzaga, Norma Crud Maciel, Helmut Sick and Dante Luiz Martins Teixeira.
Criteria for inclusion: 2a, 2b & 3a.

Rio de Janeiro lagoons (29)

Location: 22°50'-23°00'S, 42°00'-43°25'W; between Rio de Janeiro and Cabo Frio, Rio de Janeiro.
Area: 26,000 ha.
Altitude: 0-1m.
Province and type: 8.8.2; 05, 07, 08 & 12.
Site description: A chain of eleven large fresh to brackish coastal lagoons behind a sea beach from Lagoa Jacarepagua (1,400 ha) in the west to Lagoa de Araruama (15,000 ha) in the east; and a complex of salt pans, shallow saline lagoons and marshes south of Cabo Frio. Several of

the brackish lagoons have fringing mangroves and are influenced by the tides. Jacarepagua, Marapendi, Itaipu and Piratininga are in the outskirts of Rio de Janeiro and Niteroi.

Principal vegetation: Mangrove swamps with *Rhizophora mangle, Laguncularia racemosa, Conocarpus erectus* and *Avicennia* sp; marshes with Cyperaceae, *Paspalum vaginatum, Typha* sp and *Acrostichum* sp.

Land tenure: A mixture of state, municipal and private ownership.

Protection: None.

Land use: Fishing; conch fishing; extraction of salt; recreation; and some illegal hunting. In a region of extensive urban and suburban development, with the large cities of Rio de Janeiro and Niteroi in the west.

Waterfowl: Surprisingly rich in waterfowl in view of the proximity of the wetlands to large urban centres. Common residents include *Podilymbus podiceps, Phalacrocorax olivaceus, Nycticorax nycticorax, Butorides striatus, Egretta thula, E. alba, Ardea cocoi, Dendrocygna viduata, Anas bahamensis, Amazonetta brasiliensis, Gallinula chloropus, Jacana jacana* and *Charadrius collaris.* Other species recorded include *Botaurus pinnatus, Ixobrychus involucris, Cochlearius cochlearius, Oxyura dominica* and *Porphyriops melanops. Netta erythrophthalma erythrophthalma* is fairly common and known to breed; flocks of up to 80 have been recorded on Jacarepagua, Marapendi, Itaipu and Piratininga in recent years. A variety of Nearctic shorebirds occur on migration and in the austral summer, particularly on the salt pans and coastal lagoons near Cabo Frio. The commoner species include *Charadrius semipalmatus, Tringa melanoleuca, T. flavipes, Calidris alba, C. pusilla* and *C. fuscicollis. Nycticryphes semicollaris* has occurred as a winter visitor from the south.

Other fauna: No information.

Threats: The wetlands are under considerable pressure from urban expansion, the reclamation of land for industry and residential areas, and development for water sports and beach recreation. There is also a serious pollution problem from domestic and industrial waste, and some illegal hunting.

Research and conservation: Various faunal and floral studies, including bird banding projects, have been carried out by the Museu Nacional and local universities.

References: Sick & Pabst (1968); Sick & Teixeira (1979); Teixeira & Nacinovic (1981).

Source: Susana de Moura Lara-Resende, Norma Crud Maciel and Dante Luiz Martins Teixeira.

Criteria for inclusion: 2a, 2b & 3a.

Guanabara Bay (30)

Location: 22°40'-22°55'S, 42°58'-43°16'W; northeast of the city of Rio de Janeiro, Rio de Janeiro.

Area: 45,000 ha including 5,000 ha of mangroves.

Altitude: 0-2m.

Province and type: 8.8.2; 01, 07 & 08.

Site description: A large sea bay with narrow entrance to the sea between the cities of Rio de Janeiro and Niteroi; there are extensive mangrove swamps at Reconcavo in the northeast, and fringing fresh to brackish marshes and wet arable land.

Principal vegetation: Mangrove swamps with *Rhizophora mangle, Laguncularia racemosa* and *Avicennia* sp; salt marshes with *Spartina alterniflora*; and marshes with *Typha domingensis, Hibiscus pernambucensis* and *Acrostichum aureum.*

Land tenure: The bay is under Federal ownership (Marine Territory); the surrounding areas are mainly private.

Protection: An Environmental Protection Area has recently been established to protect 5,000 ha of mangroves at Reconcavo. The remainder of the area is unprotected.

Land use: Fishing; harvesting of crabs; exploitation of mangroves; and recreation. The city and port of Rio de Janeiro lie along the west shore of the Bay; other neighbouring areas are under cultivation.

Waterfowl: A wide variety of resident and migratory waterfowl occur, although in much smaller numbers than in former times. Common residents include *Phalacrocorax olivaceus, Anhinga anhinga, Egretta caerulea, E. thula, E. alba, Dendrocygna viduata, Amazonetta brasiliensis, Aramides cajanea, Gallinula chloropus, Porphyrula martinica, Jacana jacana* and *Charadrius collaris.*
Other fauna: *Hydrochoerus hydrochaeris, Caiman latirostris* and *Paleosuchus niger* occur.
Threats: The shore of the bay is under intense pressure from urban and agricultural expansion, and only the large tracts of mangroves and swamp in the northeast remain relatively undisturbed. Here the principal threats are the destruction of mangroves for fuel and timber, drainage for agriculture, and pollution from pesticide runoff.
Research and conservation: Faunal and floral studies have been carried out by the Museu Nacional, and FEEMA has conducted a study of the mangroves at Reconcavo.
References: Araujo & Maciel (1979).
Source: Norma Crud Maciel.
Criteria for inclusion: 2b & 3a.

Guaratiba Bay (31)

Location: 23°02'S, 43°37'W; west of Rio de Janeiro city, Rio de Janeiro.
Area: 1,413 ha.
Altitude: 0m.
Province and type: 8.8.2; 02, 06, 07 & 08.
Site description: An area of mangrove swamps, brackish marshes and intertidal mudflats at the eastern end of a large sea bay.
Principal vegetation: Mangrove swamps with *Rhizophora mangle, Laguncularia racemosa* and *Avicennia* sp; marshes with *Paspalum vaginatum.*
Land tenure: A mixture of federal and state ownership.
Protection: Within the Guaratiba Biological and Archeological Reserve, a state reserve.
Land use: Fishing and recreation.
Waterfowl: A variety of resident waterfowl and migrant Nearctic shorebirds occur, the residents including *Phalacrocorax olivaceus, Anhinga anhinga, Egretta caerulea, E. thula, E. alba, Ardea cocoi, Ajaia ajaja, Jacana jacana* and *Charadrius collaris.*
Other fauna: No information.
Threats: Pollution, and encroachment of residential areas; the reserve is not clearly defined.
References: Maia & Penna (1982).
Source: Norma Crud Maciel.
Criteria for inclusion: 3a.

The lower Rio Ribeira, Iguape and Lagunas de Cananeia (32)

Location: 24°25'-25°15'S, 47°15'-48°05'W; near Registro and Iguape, Sao Paulo.
Area: 120,000 ha.
Altitude: 0-10m.
Province and type: 8.7.1; 02, 05, 06, 07, 08, 09, 11 & 12.
Site description: The extensive riverine marshes of the lower Rio Ribeira and tributaries; a complex of narrow coastal inlets, fresh to brackish lagoons, mangrove swamps and intertidal mudflats around Ilha Comprida and Ilha do Cardoso; and 100 km of ocean beach with coastal dunes.
Principal vegetation: Mangrove swamps with *Rhizophora mangle, Avicennia germinans* and *Laguncularia racemosa*; sandy areas and marshes with *Ipomoea pescaprae, Spartina ciliata, Philoxerus portulacoides, Canavalia obtusifolia, Remirea maritima* and *Hydrocotyle umbellata.* In a region of humid tropical forest (Atlantic forest).
Land tenure: The Ecological Station is owned by SEMA; Ilha do Cardoso is owned by the state; other areas are mainly private.

Protection: The northeastern portion is included within the Jureia Ecological Station (30,000 ha); Ilha do Cardoso State Park includes 1,100 ha of Atlantic beach and 1,800 ha of mangroves; other areas are unprotected.
Land use: Subsistence agriculture, and commercial fishing on a small scale.
Waterfowl: An important area for both breeding and migrant waterfowl. Resident species include *Phalacrocorax olivaceus, Egretta caerulea, E. thula, E. alba, Ardea cocoi, Dendrocygna* spp, *Amazonetta brasiliensis, Aramides cajanea* and *Vanellus chilensis.* Passage migrants include *Charadrius semipalmatus, Tringa* spp, *Calidris fuscicollis* and Laridae.
Other fauna: *Procyon cancrivorus, Hydrochoerus hydrochaeris* and *Tapirus terrestris* occur.
Threats: Destruction of mangroves, and excessive disturbance from recreation at weekends.
Research and conservation: A management plan has been prepared for Ilha do Cardoso State Park; and the Lagunas de Cananeia-Iguape area is under study for the creation of a protected area.
References: Negreiros *et al* (1974); Noffs & Baptista-Noffs (1982).
Source: Susana de Moura Lara-Resende and Marcos da Silva Noffs.
Criteria for inclusion: 3a.

Baia de Laranjeiras and Baia de Paranagua (33)

Location: 25°15'-25°35'S, 48°10'-48°45'W; between Paranagua and Guaraquecaba, Parana.
Area: 76,000 ha.
Altitude: 0m.
Province and type: 8.7.1; 01, 02, 03, 07, 08 & 10.
Site description: A large sea bay complex with deeply indented shoreline, numerous small islands, and the estuaries of several small fast-flowing rivers; there are some estuarine marshes and mangrove swamps. The bay is up to 10m deep, and has a tidal rise and fall of about 1m.
Principal vegetation: In a region of humid tropical forest (Atlantic forest).
Land tenure: No information.
Protection: The northeastern portion is included within the recently established Guaraquecaba Ecological Station (73,640 ha); the remainder is unprotected.
Land use: Fishing. The area is little disturbed.
Waterfowl: Little information is available, but the area is known to be rich in Ardeidae and Rallidae.
Other fauna: There is a large breeding colony of *Sula leucogaster* and *Fregata magnificens* on an island in Paranagua Bay. The area is particularly important for its population of the endangered parrot *Amazona brasiliensis.*
Threats: The surrounding forests are being destroyed, and there is some trapping of birds for the pet trade.
Source: Pedro Scherer Neto.
Criteria for inclusion: 2a & 3a.

Rio Iguacu and Iguacu Falls (34)

Location: 25°05'-25°41'S, 53°40'-54°38'W; 20 km southeast of Foz do Iguacu, on the Argentinian border, Parana.
Area: Unknown.
Altitude: 150-275m.
Province and type: 8.8.2; 10.
Site description: Approximately 170 km of the Rio Iguacu, a large, relatively fast-flowing river with spectacular falls which drop 80m over a distance of 2,700m. The flow in the river has recently been affected by the construction of a large hydroelectric dam 300 km upstream at Osorio. Contiguous with Argentina site 14.
Principal vegetation: In relatively undisturbed humid subtropical forest with some *Araucaria angustifolia* and the palms *Euterpe edulis* and *Cocos romanzoffiana.*
Land tenure: The greater part of the National Park is owned by IBDF.

Protection: Included within the Iguacu National Park (170,086 ha), established in 1939 and modified in 1944.
Land use: Tourism in the National Park.
Waterfowl: A variety of waterfowl breed in the Park, including *Anhinga anhinga, Mesembrinibis cayennesis, Cairina moschata, Heliornis fulica* and *Charadrius collaris.* The rare *Mergus octosetaceus* was recorded as an occasional visitor until at least the 1970s, and the endangered nominate race of *Tigrisoma fasciatum* may still occur.
Other fauna: There is a large roost of the rather local swift *Cypseloides senex* at the falls, and the endangered piping-guan *Pipile jacutinga* occurs in the surrounding forests. Mammals include *Pteronura brasiliensis, Lutra platensis, Hydrochoerus hydrochaeris* and *Tapirus terrestris*; reptiles include *Caiman latirostris* and *Paleosuchus palpebrosus.*
Threats: Increasing turbidity of the Rio Iguacu and its tributaries as a result of watershed degradation outside the park, and alterations in flow caused by the hydroelectric dam at Osorio are the main problems. There is some encroachment by settlers, forest clearance and hunting in the Park, and tourists cause a considerable amount of disturbance, particularly in low-flying helicopters.
Research and conservation: A variety of faunal and floral investigations have been conducted in the Park.
References: IUCN (1982).
Source: Derek A. Scott.
Criteria for inclusion: 2a, 3a & 3b.

Tubarao Lagoons (35)

Location: 28°02'-28°40'S, 48°40'-49°03'W; east of Tubarao, Santa Catarina.
Area: 50,000 ha.
Altitude: 0-5m.
Province and type: 8.8.2; 02, 07 & 08.
Site description: Lagoa do Mirim (18,000 ha), Lagoa Garopaba (3,500 ha), and about ten smaller brackish coastal lagoons with extensive marshes between Garopaba in the north and Jaguaruna in the south. There are some mangrove swamps, here at the extreme southern limit of their occurrence on the Atlantic coast.
Principal vegetation: No information.
Land tenure: No information.
Protection: None.
Land use: No information.
Waterfowl: No information.
Other fauna: No information.
Threats: No information.
Source: Paulo de Tarso Zuquim Antas.
Criteria for inclusion: 0.

Lagoa do Sombrio (36)

Location: 29°10'S, 49°40'W; 60 km southwest of Criciuma, Santa Catarina.
Area: 5,060 ha.
Altitude: 0m.
Province and type: 8.32.11; 07.
Site description: A large brackish coastal lagoon, up to 3m deep, and several small lagoons nearby, with brackish marshes and surrounding sandy areas. Water levels fluctuate with the local rainfall.
Principal vegetation: Marshes with Cyperaceae and *Typha* sp; in a region of open grasslandand scrub.
Land tenure: A mixture of state and municipal ownership.
Protection: None.

Land use: Cattle ranching in surrounding areas.
Waterfowl: Resident breeding species include *Podilymbus podiceps*, *Gallinula chloropus*, *Fulica armillata* and *F. rufifrons*. The wetland is of chief importance as a wintering area for waterfowl breeding further south; these include *Phalacrocorax olivaceus*, *Egretta alba*, *Ardea cocoi*, *Dendrocygna bicolor*, *D. viduata*, *Cygnus melancoryphus* and *Netta peposaca*.
Other fauna: The area is rich in passerines associated with wetland habitats.
Threats: Drainage canals have been dug to reclaim land for cattle grazing.
Research and conservation: Preliminary avifaunal surveys have been conducted in the area.
Source: Lenir Alda do Rosario Bege and Selma Mattos Diniz.
Criteria for inclusion: 2b & 3a.

Tramandai Lagoons (37)

Location: 29°22'S, 49°48'W to 30°23'S, 50°20'W; from Torres south along the coast to 50 km south of Tramandai, Rio Grande do Sul.
Area: 42,000 ha.
Altitude: 0-5m.
Province and type: 8.32.11; 07 & 12.
Site description: A chain of lakes and lagoons with associated marshes stretching for 125 km along the coast of northern Rio Grande do Sul, separated from the sea by a belt of sand dunes 3-5 km wide. The great majority are fresh, but four lagoons near Tramandai (Tramandai, Armazem, Custodia and Gentil) are brackish with salinities ranging up to 30 p.p.t. The largest lakes are Itapeva (9,516 ha), dos Quadros (11,900 ha), Malvas (1,500 ha), Palmital (1,172 ha), Pinguela (2,908 ha), Tramandai (1,286 ha), Fortaleza (1,854 ha) and Porteira (1,868 ha). The maximum depth varies from about 1.5m to 3.5m, and the levels fluctuate seasonally by 50 cm to 1m.
Principal vegetation: Freshwater lakes and marshes with *Scirpus californicus*, *S. giganteus*, *Paspalidium paludivagum*, *Eichhornia crassipes*, *E. azurea*, *Pistia stratiotes*, *Potamogeton* sp, *Salvinia* sp, *Elodea densa*, *Fuerena robusta*, *Nymphoides indica* and *Cabomba australis*; brackish lagoons with *Scirpus californicus*, *S. olneyi*, *Ruppia maritima*, *Trapa* sp, *Potamogeton pectinatus*, *Ceratophyllum demersum* and *Chara* sp. Surrounding areas with dune vegetation, pastureland and rice cultivation.
Land tenure: Mainly private ownership; some lakes are partly owned by the state or local municipalities.
Protection: None.
Land use: Cattle ranching, traditional fishing and recreation. There is commercial fishing at some lakes, and pisciculture at Lagoa dos Quadros. The waters of Lagoa Rincao das Eguas and Lagoa Porteira are used to irrigate rice cultivation.
Waterfowl: An important area for a wide variety of breeding waterfowl and migrants from both the north and the south. Belton records over 65 species including *Rollandia rolland*, *Podiceps major*, *Botaurus pinnatus*, *Ixobrychus involucris*, *Mycteria americana*, *Euxenura maguari*, *Chauna torquata*, *Anas georgica*, *A. versicolor*, *Netta peposaca* (mainly a winter visitor), *Cairina moschata*, *Oxyura dominica*, *Rallus sanguinolentus*, *R. nigricans*, *R. maculatus*, *Aramides saracura*, *Fulica armillata*, *F. leucoptera*, *Gallinago (g.) paraguaiae* and *Larus maculipennis*. Migrant shorebirds include *Charadrius falklandicus*, *C. modestus* and *Eudromias ruficollis* from southern South America, and 13 regular visitors from the Nearctic.
Other fauna: No information.
Threats: There is some pollution from domestic sewage at Lagoa Marcelino, Laguna Tramandai and Lagoa Armazem.
Research and conservation: Limnological studies have been conducted at all the lakes by Chomenko (1981) and Schwarzbold (1982), and the avifauna has been studied by Belton (1984). Priority areas for protection include Lagoa Malvas, Lagoa Rincao I, Lagoa Rincao II and Lagoa Pombas.
References: Chomenko (1981); Schwarzbold (1982); Belton (1984).
Source: Walter A. Voss.
Criteria for inclusion: 3a.

Lagoa do Peixe and nearby lakes (38)

Location: 30°24'S, 50°20'W to 31°55'S, 51°54'W; along the coast east of Lagoa dos Patos, Rio Grande do Sul.
Area: 11,300 ha of lakes and lagoons.
Altitude: 0-4m.
Province and type: 8.32.11; 05, 07 & 12.
Site description: A chain of 23 small freshwater lakes and marshes, and the large shallow brackish to saline Lagoa do Peixe (4,370 ha), stretching for 240 km along the inland side of the coastal sand dunes between Lagoa dos Patos and the Atlantic; the seaward side of the dunes is a continuous ocean beach. Lagoa do Peixe varies in depth from 10-80 cm, and the salinity ranges from 1-40 p.p.t.; the lagoon is connected to the sea by a channel during the rainy season (winter and spring). The shores are muddy and sandy, and there is little aquatic vegetation. Most of the freshwater lakes are under 500 ha in area, but Lagoa Quintao, Lagoa dos Barros and Lagoa Figueira in the north exceed 700 ha, and the southernmost lake, Lagoa Tuneira, is 1,760 ha. The maximum depths range from under 1m to 11m, and levels fluctuate seasonally by about 50 cm. Lagoa Moleques and Lagoa Figueira are exceptional in being oligotrophic.
Principal vegetation: Some sparse halophytic vegetation and *Paspalum vaginatum* at Lagoa do Peixe; freshwater lakes and marshes with *Scirpus californicus, S. giganteus, Paspalidium paludivagum, Potamogeton illinoensis, Eichhornia azurea, Zizaniopsis bonariensis, Pontederia lanceolata, Echinodorus grandiflorus, Nymphoides indica, Ceratophyllum demersum* and *Chara* sp. Sand dune vegetation to the east and grassland to the west, with some plantations of *Pinus* and *Eucalyptus* spp in northern areas, and native coastal scrub in the south.
Land tenure: Private and public (Navy) ownership.
Protection: None.
Land use: Cattle ranching throughout; some recreation at lakes in the north; a little traditional fishing; commercial shrimp fishing at Lagoa do Peixe; sport hunting; and rice cultivation and forestry in surrounding areas. The waters of several lakes are used for irrigation in rice cultivation, particularly in the north.
Waterfowl: A very important area for a wide variety of waterfowl. Lagoa do Peixe is particularly important as a staging area and wintering area for migrant waterfowl breeding further south and for Nearctic shorebirds. The southern migrants include *Phoenicopterus chilensis* (up to 200), *Coscoroba coscoroba, Cygnus melancoryphus, Anas flavirostris, A. sibilatrix, A. georgica, Netta peposaca, Charadrius falklandicus* (over 5,000), *C. modestus* (over 1,000) and *Larus maculipennis*. Nearctic migrants include *Pluvialis dominica, Limosa haemastica* (up to 1,000 on passage in April/May and October), *Tringa melanoleuca, T. flavipes, Calidris canutus* (up to 20,000 on passage in April and May), *C. alba, C. fuscicollis* (many thousands), *C. melanotos* and *Sterna hirundo* (up to 8,000 in April and May). Common resident shorebirds include *Haematopus palliatus, Vanellus chilensis* and *Himantopus himantopus*.
Other fauna: No information.
Threats: Drainage of marshes at Lagoa do Fundo and Lagoa Pai Joao for forestry; fish farming with exotic species at Lagoa do Peixe; and destruction of coastal habitat for tourist recreation, particularly in the north. Forestry projects are affecting wind patterns and hence the movement of sand dunes, which has had a detrimental effect on some lakes. Proposals have been made to alter water levels in Lagoa do Peixe to improve fishing.
Research and conservation: Some shorebird censuses and banding programmes have been carried out by CEMAVE, the Fundacao Zoobotanica do Rio Grande do Sul, and the University of Porto Alegre. Chomenko (1981) and Schwarzbold (1982) have conducted limnological studies at all the lakes; and a research project on the importance of Lagoa do Peixe for waterfowl has recently been initiated by Susana de Moura Lara-Resende. Areas particularly worthy of protection include Lagoa do Peixe and surrounding areas; Lagoa Tuneira in the south; Lagoa Rebeca, Lagoa Cinza, Lagoa Papagaio I and II, and Lagoa Ponche in the north; and the oligotrophic lakes Moleques and Figueira.
References: Chomenko (1981); Schwarzbold (1982); Morrison (1983a); Belton (1984).
Source: Paulo de Tarso Zuquim Antas, Susana de Moura Lara-Resende, Flavio Silva and Walter A. Voss.
Criteria for inclusion: 123.

Lagoa dos Patos (39)

Location: 29°55'-32°00'S, 50°20'-52°15'W; south of Porto Alegre, Rio Grande do Sul.
Area: 1,567,000 ha (Lagoa dos Patos 985,000 ha; other lakes and marshes 582,000 ha).
Altitude: 0-10m.
Province and type: 8.32.11; 09, 12, 13, 16 & 17.
Site description: Lagoa dos Patos, the largest lake in Brazil, is a deep freshwater lake 250 km long by 50 km wide with a wide connection with the sea at Rio Grande in the south which enables shipping to enter the lake and service a large port at Porto Alegre in the extreme north. In the surrounding low-lying areas there are some 135 freshwater lakes of 100 to 2,000 ha in extent, extensive marshes, and large areas of seasonally flooded grassland and rice cultivation. Two of the most important areas for wildlife are the Lagoa do Capivari marshes (500 ha) and Pontal dos Gateados complex of lakes, marshes and wet grassland (5,000 ha) to the northeast of the main lake.
Principal vegetation: Freshwater marshes with *Scirpus* spp, *Zizaniopsis* sp, *Eichhornia crassipes, E. azurea* and *Salvinia* sp; and woodland and shrubbery with *Salix* sp, *Mimosa bimocronata, Cephalanthum glabratus* and *Erythrina cristagalli.* Pastureland and rice cultivation in surrounding areas.
Land tenure: Mainly private ownership.
Protection: None.
Land use: Fishing, cattle and horse ranching, rice cultivation and sport hunting.
Waterfowl: An extremely important area for waterfowl, with large breeding populations of Ardeidae, Threskiornithidae and Anatidae, particularly in the the extensive marshes to the northeast of Lagoa dos Patos. There are several large mixed breeding colonies in the Lagoa do Capivari and Pontal dos Gateados areas, the largest with some 15,000 pairs. The principal species are *Phalacrocorax olivaceus, Nycticorax nycticorax, Bubulcus ibis, Butorides striatus, Egretta thula, E. alba, Ardea cocoi, Euxenura maguari, Phimosus infuscatus, Plegadis chihi* and *Ajaia ajaja.* Other breeding species include *Botaurus pinnatus, Harpiprion caerulescens, Chauna torquata, Dendrocygna bicolor, D. viduata, Anas versicolor, Amazonetta brasiliensis, Aramus guarauna, Rallus sanguinolentus, Gallinula chloropus, Porphyrula martinica*, three species of *Fulica, Jacana jacana, Vanellus chilensis, Himantopus himantopus* and *Larus maculipennis. Coscoroba coscoroba* breeds at Pontal dos Gateados at the northern limit of its range in Brazil. The area is also important for wintering Anatidae from southern South America, and Nearctic shorebirds, particularly *Pluvialis dominica, Tringa* spp, *Calidris melanotos* and *Tryngites subruficollis.*
Other fauna: The marshes support a very large breeding population of *Rostrhamus sociabilis.* Mammals include *Hydrochoerus hydrochaeris* and *Myocastor coypus*; and reptiles include *Caiman latirostris* and *Platemys spixii.* The whole system supports an extremely important fishery.
Threats: There is a considerable amount of pollution in Lagoa dos Patos from the city, port and industrial areas of Porto Alegre in the north and Rio Grande in the south. Petrochemical installations and a cellulose factory near Porto Alegre are particularly harmful. In the surrounding wetlands, the principal threat is drainage for pastureland and rice cultivation. Hunting is inadequately controlled, and the breeding colonies of Ciconiiformes are heavily persecuted by egg collectors.
Research and conservation: The Federal University of Rio Grande do Sul has conducted limnological studies, and biologists from IBDF and the Fundacao Zoobotanica do Rio Grande do Sul have banded waterfowl, particularly Ardeidae and Threskiornithidae.
References: Belton (1984).
Source: Flavio Silva.
Criteria for inclusion: 123.

Lagoa Mirim, Lagoa Mangueira and the Taim marshes (40)

Location: 32°10'-33°40'S, 52°30'-53°30'W; near the Uruguayan border in extreme southeastern Brazil, Rio Grande do Sul.
Area: 850,000 ha (Lagoa Mirim 230,000 ha; Lagoa Mangueria 80,200 ha).

Altitude: 0-5m.
Province and type: 8.32.11; 05, 07, 12, 13, 16 & 17.
Site description: Lagoa Mirim is a brackish lake with a hard sand and mud shoreline, and relatively little aquatic vegetation; its total area is approximately 330,000 ha, of which 230,000 lie in Brazil and the remainder in Uruguay (see Uruguay site 9). Lagoa Mangueira (80,200 ha) is a long narrow freshwater lake, up to 4m deep, paralleling the coast to the east of Lagoa Mirim. The rest of the area is a vast complex of some 120 shallow freshwater lakes and marshes, seasonally flooded grassland, rice cultivation, and higher areas of dry savanna and native woodland, with a broad strip of coastal sand dunes and ocean beach in the east. The larger lakes include Lagoa Caiuba (1,750 ha), Lagoa da Flores (1,130 ha), Lagoa Nicola (258 ha) and Lagoa Jacare (145 ha).
Principal vegetation: Freshwater lakes and marshes with *Scirpus californicus, Zizaniopsis bonariensis, Paspalidium paludivagum, Myriophyllum brasiliensis, Ceratophyllum demersum, Cabomba australis, Eichhornia crassipes, E. azurea, Pistia stratiotes, Echinodorus grandiflorus* and *Salvinia* sp; scattered shrubs of *Cephalatum, Mimosa* and *Salix*; patches of native woodland with *Ficus enormis, Erythrina cristagalli* and bromeliads; and sand dune vegetation in the east. Also plantations of *Pinus* and *Eucalyptus.*
Land tenure: Mainly under private ownership in large ranches; the Ecological Station is owned by SEMA.
Protection: 32,038 ha of lakes, marshes and wet grassland, including Lagoa Nicola, Lagoa Jacare and the northern end of Lagoa Mangueira, are protected in the Taim Ecological Station. The remainder of the area is unprotected.
Land use: Cattle, sheep and horse ranching; cultivation of rice and soya beans; fishing; sport hunting; and some forestry. Water is taken from some of the lakes for rice cultivation, and there is commercial fishing in Lagoa Mangueira. An international highway passes through the middle of the area (and the Ecological Station).
Waterfowl: One of the richest areas for waterfowl in South America, with a great diversity of resident breeding species, winter visitors from southern breeding areas, and passage and "wintering" Nearctic shorebirds. Over sixty species of waterfowl were observed during a three day visit to the Taim area in January 1982. Common breeding species include *Podilymbus podiceps, Rollandia rolland, Podiceps major, Phalacrocorax olivaceus, Nycticorax nycticorax, Syrigma sibilatrix, Butorides striatus, Egretta thula, E. alba, Ardea cocoi, Mycteria americana, Euxenura maguari, Harpiprion caerulescens, Phimosus infuscatus, Plegadis chihi, Ajaia ajaja, Chauna torquata, Dendrocygna viduata, Coscoroba coscoroba, Cygnus melancoryphus, Anas flavirostris, A. georgica, A. versicolor, Netta peposaca, Amazonetta brasiliensis, Heteronetta atricapilla, Aramus guarauna, Aramides ypecaha, Porphyriops melanops, Gallinula chloropus, Fulica armillata, F. leucoptera, F. rufifrons, Jacana jacana, Haematopus palliatus, Vanellus chilensis, Charadrius collaris, Gallinago (g) paraguaiae, Himantopus himantopus, Larus maculipennis, Phaetusa simplex, Sterna superciliaris* and *Rynchops niger.*

Large numbers of southern Anatidae and shorebirds visit the area in the austral winter, including *Anas sibilatrix, Charadrius falklandicus* and *C. modestus. Phoenicopterus chilensis* occurs in small numbers, and *Nycticryphes semicollaris* has been recorded. Common Nearctic migrants during the migration seasons and in the austral summer include *Pluvialis dominica, Limosa haemastica, Tringa melanoleuca, T. flavipes, Calidris alba, C. fuscicollis, C. melanotos, Micropalama himantopus* and *Tryngites subruficollis.*
Other fauna: Birds of prey are common, and include *Rostrhamus sociabilis, Circus cinereus, C. buffoni* and *Falco peregrinus.* Mammals include *Hydrochoerus hydrochaeris, Myocastor coypus* and *Blastocerus dichotomus*; and reptiles include *Caiman latirostris* and *Platemys* sp.
Threats: The principal threats are drainage of wetlands for pastureland and cultivation, and the extensive use of pesticides on agricultural land. Grasslands are heavily overgrazed; there is a considerable amount of illegal hunting; and breeding colonies of Ardeidae and Threskiornithidae are persecuted by egg collectors. Wardening in the Ecological Station is reported to be inadequate.
Research and conservation: There are excellent facilities for research at Taim Ecological Station, and a number of faunal and floral surveys have been carried out there. The Fundacao Zoobotanica do Rio Grande do Sul and CEMAVE have banded waterfowl, and Schwarzbold (1982) has conducted limnological studies of some lakes.
References: Marigo (1977); MINTER & SEMA (1977); Schwarzbold (1982); Morrison (1983a); Belton (1984).

Source: Susana de Moura Lara-Resende, Flavio Silva and Walter A. Voss.
Criteria for inclusion: 123.

The lower Rio Ibicui and Rio Uruguay marshes (41)

Location: 28°40'-29°40'S, 56°05'-56°55'W; between Sao Borja and Uruguaiana, Rio Grande do Sul.
Area: 107,500 ha.
Altitude: 60m.
Province and type: 8.32.11; 09, 11, 12, 16 & 17.
Site description: A complex of freshwater lakes and seasonally inundated alluvial plains along the Rio Ibicui and its tributaries, with extensive areas of rice cultivation. Much of the natural wetland habitat has been converted into rice fields.
Principal vegetation: No information.
Land tenure: Privately owned.
Protection: None.
Land use: Rice cultivation and grazing.
Waterfowl: Belton records over 55 species of waterfowl typical of the basin of the Rio de La Plata. Residents include *Anhinga anhinga, Botaurus pinnatus, Ixobrychus involucris, Tigrisoma lineatum, Euxenura maguari, Phimosus infuscatus, Chauna torquata, Dendrocygna bicolor, D. viduata, Amazonetta brasiliensis, Cairina moschata, Oxyura dominica, Aramus guarauna, Aramides ypecaha, Porphyriops melanops, Gallinago (g.) paraguaiae, Phaetusa simplex, Sterna superciliaris* and *Rynchops niger*. Migrant include a variety of Anatidae and *Charadrius modestus* from the south, and *Pluvialis dominica, Bartramia longicauda, Tringa* spp, *Calidris fuscicollis* and *C. melanotos* from the Nearctic.
Other fauna: No information.
Threats: Continuing drainage of wetlands for agriculture.
Research and conservation: The avifauna of the region has been studied by Belton (1984).
References: Belton (1984).
Criteria for inclusion: 0.

Dams in Brazil (42)

Type: 15.
Site description: In recent decades, a number of enormous dams have been constructed in Brazil for hydroelectricity, irrigation and water supply to urban centres. Many others are under construction or in the planning stages, and within the next twenty years virtually every major river in the country will have been dammed, sometimes in several places. Some of the principal dams already completed are as follows:

Boa Esperanza Dam: 6°40'7°30'S, 43°30'45°00'W; on the upper Rio Parnaiba, Maranhao and Piaui; 155,000 ha; 110m above sea level.
Abras Dam: 4°20'S, 40°27'W; on the upper Rio Acarau, Ceara; 28,500 ha; 200m.
Oros Dam: 6°15'S, 39°00'W; on the upper Rio Jaguaribe, Ceara; 32,500 ha; 200m.
Sao Francisco Dam: 9°00'11°20'S, 40°50'43°10'W; on the Rio Sao Francisco, Bahia; 900,000 ha; 380m.
Parnaiba Dams: 19°35'20°48'S, 50°40'51°38'W; two contiguous dams on the Rio Parnaiba, Mato Grosso do Sul, Sao Paulo and Minas Gerais; 150,000 ha; 305m.
Tres Marias Dam: 18°30'S, 45°15'W; on the upper Rio Sao Francisco, Minas Gerais; 120,000 ha; 595m.
Furnas Dam: 20°30'21°30'S, 45°15'46°20'W; on the Rio Grande and lower Rio Sapucai, Minas Gerais; 180,000 ha; 745m.
Rio Tiete Dams: 21°25'S, 49°30'W; a chain of dams on the Rio Tiete, Sao Paulo; over 100,000 ha; 400m.
Paranapanema Dam: 23°15'S, 49°00'W; on the Rio Paranapanema, Sao Paulo; 60,000 ha; 570m.

Itarare Dam: 23°20'S, 49°40'W; on the Rio Itarare, Sao Paulo and Parana; 65,000 ha; 550m.

Passo Fundo Dam: 27°40'S, 52°45'W; on a tributary of the Rio Uruguay, Rio Grande do Sul; 15,000 ha; 550m.

Rincao da Estrela Dam: 28°55'S, 53°10'W; on the upper Rio Jacui, Rio Grande do Sul; 35,000 ha; 300m.

Itaipu Hydroelectric Dam: 24°30'S, 54°20'W; on the Rio Parana on the Paraguayan border, Parana; 146,000 ha; 195m.

Large dams completed, under construction, or in the planning stages in the Amazon Basin are listed under site 1.

Most of the dams have deeply indented shorelines, widely fluctuating water levels, and little aquatic vegetation, except at river mouths. In general, they are of little importance for native wildlife, although some have developed important fisheries following the introduction of exotic species. Several dams are known to be of importance for Nearctic shorebirds on migration (e.g. the Parnaiba, Rio Tiete and Paranapanema dams), and some resident waterfowl have adapted well to the new conditions, particularly *Phalacrocorax olivaceus*, several Ardeidae and *Dendrocygna viduata*. In the east and northeast, the rare *Netta erythrophthalma erythrophthalma* has recently begun to occur in significant numbers on dams.

Tundisi (1981) has conducted limnological studies at 35 dams in Sao Paulo State, and researchers elsewhere are increasingly taking an interest in these new water bodies, but on the whole, the importance of the dams for wildlife and their ecological effects on neighbouring and downstream areas remain poorly known.

CHILE

INTRODUCTION

by **Roberto P. Schlatter and Luis A. Espinosa**

Chile is situated in the south of the South American continent. It has an area of approximately 624,593km^2 and a population of 11 million (1979).

According to Mann's classification of climax vegetation types (Mann, 1964), Chile possesses five main communities: desert, thicket (matorral), savanna, steppe and montane. However, a more recent and precise classification is that of Castri (1968), based on bioclimatic zones. On this classification, Chile is divided into the following zones:

a) Desertica litoral; the narrow coastal strip of desert from Arica to central Atacama.
b) Desertica del interior; the interior desert between the littoral zone and the Andes, from Arica to central Atacama.
c) Tropical marginal; the subdesert of the Pacific slope between the interior desert and the altiplano, from Tarapaca to central Atacama.
d) Tropical de altura; the altiplano of the Andes from Tarapaca to central Atacama.
e) Mediterranea periarida; the transition zone between the desert and arid Mediterranean zones, between the coast and the base of the Andes from central Atacama to northern Coquimbo.
f) Mediterranea arida; the arid Mediterranean zone from the Andean foothills of Atacama and Coquimbo to central Aconcagua.
g) Mediterranea semiarida; the semi-arid Mediterranean zone in the coastal zone and coastal ranges of Aconcagua, and in Valparaiso and north central Santiago.
h) Mediterranea subhumeda; the subhumid Mediterranean zone from central Santiago through O'Higgins and Colchagua to central Curico, Talca and Maule.
i) Mediterranea humeda; the humid Mediterranean zone in the coastal zone and coastal ranges of Curico and Talca, and in eastern and southern Maule, eastern Linares, Concepcion, Nuble, Bio-Bio and eastern Malleco.
j) Mediterranea perhumeda; the very humid Mediterranean zone including Arauco, half of Cautin, the region between the humid Mediterranean zone and the Andes in Malleco, central Osorno and a small region to the south of Valdivia.
k) Oceanica con influencia mediterranea; a humid temperate zone including southern Cautin, much of Valdivia, much of Osorno, Llanquihue and Chiloe.
l) Oceanica templado-frio; a cold temperate zone in northwestern Aysen and from the coast to eastern Aysen.
m) Oceanica sub-antartica; the subantarctic zone of southern Aysen and the western half of Magallanes.
n) Oceanica trans-andina; the southern Andes and Patagonian region of eastern Aysen and southeastern Magallanes.
o) Andina; the high Andean zone above the tree-line from central Atacama to Malleco and northern Magallanes.

This bioclimatic diversity gives rise to a wide variety of wetland types, including salars in desertic regions, subantarctic tundra, peat bogs, estuaries, saline rivers, oligotrophic lakes, Andean meadows (bofedales), fiords with relatively fresh surface waters, etc.

Institutional Base for Wetland Conservation and Research

Governmental

Servicio Nacional Forestal (CONAF) and Servicio Agricola Ganadero (SAG), in the Ministerio de Agricultura.
Instituto Antartico Chileno (INACH), in the Ministerio de Asuntos Exteriores.
Corporacion de Fomento (CORFO), in the Ministerio de Hacienda.
Consejo Monumentos Nacionales, in the Ministerio de Educacion Publica.

Servicio Nacional de Obras Sanitarias (SENDOS), in the Ministerio de Obras Publicas.
Universidad de Chile.

Non-governmental
Instituto de la Patagonia.
Comite Pro Defensa de la Fauna y Flora (CODEF).
Sociedad Vida Silvestre de Chile.
Universidad Austral de Chile.
Universidad de La Concepcion.
Universidad de Valparaiso.
Universidad Catolica de Chile.
Comite de Limnologia de Chile.
Instituto de Ecologia de Chile.

Progress in Wetland Conservation and Research

In 1981, Chile ratified the Ramsar Convention and thus became the first country in the Neotropical Realm to join the Convention. On ratification, Chile designated a wetland of 4,877 ha to the north of Valdivia for inclusion in the Ramsar Convention List of Wetlands of International Importance. The wetland had been formed by subsidence during an earthquake in 1960. No further wetlands have been designated for inclusion in the List because Chile has not as yet established the technical, administrative and scientific body necessary for the application of a suitable wetlands policy as recommended by the Ramsar Convention.

However, the National System of Protected Areas (Sistema Nacional de Areas Protegidas) currently includes some 14,428,513 ha of which at least 6,809,626 ha (47%) are wetlands.

Chile has 35 National Parks (six of which are Biosphere Reserves), 30 Forest Reserves, five Natural Monuments and 16 Nature and Scientific Sanctuaries (Santuarios de la Naturaleza e Investigacion Cientifica). A new law has recently been passed creating a system of State Protected Areas (Sistema Nacional de Areas Silvestres Protegidas del Estado). This contains three categories of conservation area: National Parks, National Monuments and Forest Reserves.

Although the total area of the protected zones represents 19% of the total area of Chile, the protected areas do not give adequate coverage to the wetlands, since the National Parks, Forest Reserves and so on were not created with this specific aim in mind. Furthermore, the 7,422,275 ha of Forest Reserves can be disregarded since these are areas for the exploitation of timber and rational use of forest resources; livestock grazing and farming are permitted, and environmental protection is not given proper attention.

Within the National System of Protected Areas, wetlands are best represented in southern Chile, i.e. in the "oceanico subantartico" and "oceanico templado-frio" bioclimatic zones, and poorly represented in the Mediterranean bioclimatic zones and coastal zone. However, with the new legislation concerning the "Sistema Nacional de Areas Silvestres Protegidas del Estado" having been approved at high level in Government, it is hoped that the situation can be improved, and an adequate representation of all the bioclimatic zones and ecosystems of Chile included within the system of protected areas.

To achieve this, it would be necessary to include additional wetland areas such as river mouths of importance for migratory waterfowl, or some of the many lakes and salars in the high Andes, of importance for flamingos. The areas proposed for protection total some 3,157,050 ha, 68% of which is comprised of wetlands; protection of these areas would give adequate representation to Chile's wetlands in the reserve network.

No large scale programme for the study of waterfowl has as yet been established in Chile. An attempt is being made to establish an international programme for the banding and colour-marking of the Black-necked Swan *Cygnus melancoryphus*, and it is hoped that an in-depth study of this species will be initiated at the Santuario de la Naturaleza e Investigacion Cientifica "Carlos Anwandter" in Valdivia, with the aim of managing and maintaining the existing population.

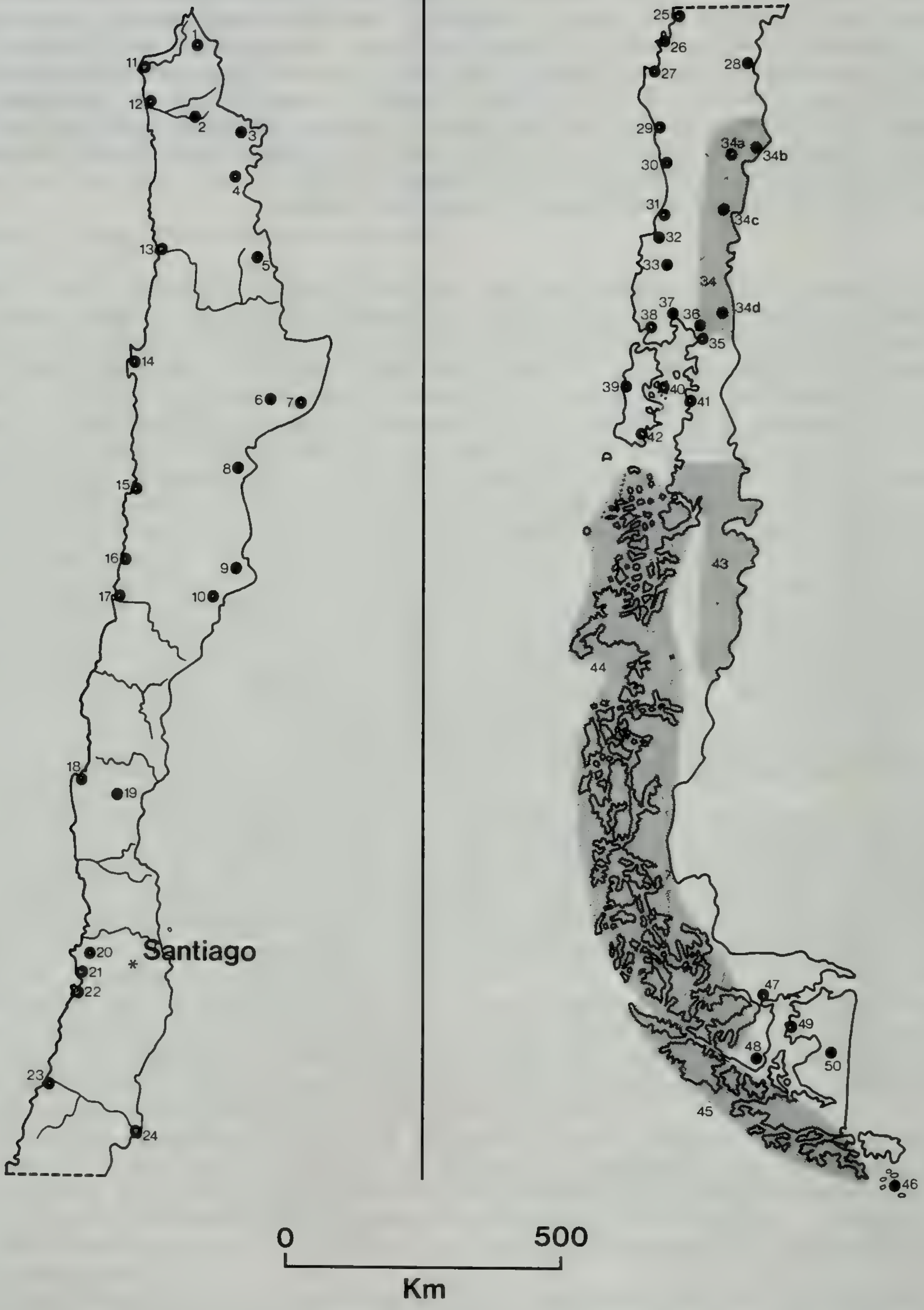
Migratory shorebirds have been banded in a programme initiated in 1983 by the Philadelphia Academy of Natural Sciences, the Universidad Austral de Chile, the Universidad de Antofagasta and others.

Major Threats to Wetlands and Waterfowl

The principal threats to wetlands and waterfowl in Chile are various. In the estuaries and on the coast, there is direct and indirect pollution from discharge of domestic waste from cities; this is particularly serious in the Bio-Bio and Aconcagua rivers. Industrial pollution is also a problem, particularly near cities such as Iquique, Chañaral and Coquimbo.

Other problems include the collection of birds' eggs, illegal hunting, violations of the hunting laws (particularly with respect to bag limits), drainage of land for rice cultivation, the use of insecticides, and pollution from mining activities. Man's gradual modification of the natural environment is a serious problem; rivers have been canalized, river banks have been deforested, and in many parts of the country domestic livestock have been introduced into wetlands and have trampled and destroyed aquatic vegetation. The oligotrophic lakes in the south are beginning to be visited by tourists and used for recreation; this is causing disturbance to waterfowl, particularly during the breeding season. Finally, it can be said that the country in general does not possess a high degree of conservation awareness.

CHILE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WETLANDS

Site descriptions based on data sheets provided by Roberto Schlatter and Luis A. Espinosa, information from Jon Fjeldsa and Carlos Guerra, and the literature.

Wetlands in Lauca National Park (1)

Location: 18°25'S, 69°10'W; 120 km east of Arica, Region I.
Area: 49,850 ha of wetlands.
Altitude: 4,500-4,600m.
Province and type: 8.36.12; 10, 12, 14 & 19.
Site description: A number of permanent fresh, brackish and saline lakes and marshes on a high Andean plateau with large areas of perennial Andean meadowland (bofedales) and fast flowing mountain rivers and streams. The principal lakes are Chungara (fresh, 2,200 ha, 4,520m), Cotacotani (brackish, 450 ha, 4,350m), Parinacota (brackish, 40 ha, 4,350m) and the Salar de Surire (saline, 25,000 ha, 4,140m). The wetlands are situated in the arid Andean steppe zone.
Principal vegetation: Wet meadowlands (bofedales) with *Oxcycloe andina, Gentiana prostata, Hipochoeris eriolaena, Hypsela oligophylla* etc, shrubby steppe (tolares) with *Baccharis, Parastrephia, Fabiana, Verbena* etc, and puna grassland with *Festuca acanthophylla, Stipa leptostachys* and *Stipa frigida.*
Land tenure: Mainly state owned (fiscal), with some private holdings.
Protection: In the Lauca National Park (484,000 ha) established in 1980, and Biosphere Reserve (520,000 ha) established in 1981.
Land use: Traditional pastoral farming by native Indian communities and a little tourism.
Waterfowl: The park has a very rich and varied avifauna with large numbers of most of the typical high Andean waterfowl and a very high population of *Fulica gigantea* (several thousand birds). *Merganetta armata* is common on the rivers; *Charadrius alticola, Eudromias ruficollis, Phegornis mitchellii, Recurvirostra andina* and *Attagis gayi* breed, and *Fulica cornuta* has occurred. All three Andean species of flamingo occur in large numbers at Salar de Surire (up to 4,000 *Phoenicopterus chilensis*, 5,000 *Phoenicoparrus andinus* and 6,000 *P. jamesi*), and *P. chilensis* breeds. *P. jamesi* is thought to have nested in 1972. Much smaller numbers of flamingos occur at times on several of the other lakes. Several Nearctic shorebirds occur during the austral summer, notably *Calidris bairdii* and *Steganopus tricolor.*
Other fauna: Other interesting wildlife in the park includes *Pterocnemia pennata tarapacensis, Lama guanacoe, Vicugna vicugna* and *Hippocamelus antisensis.*
Threats: There is a proposal to use the waters of Lake Chungara for irrigation, and the construction of a railroad has caused erosion problems. Overgrazing by llamas and alpacas, and exploitation of mineral deposits are also causing problems.
Research and conservation: A considerable amount of research has been conducted in the park, much of this on the Vicuna, and a management plan for the park has been produced.
References: Kahl (1975); McFarlane (1975b & 1975c); Hurlbert (1978 & 1981); Torres *et al* (1978); IUCN (1982); CONAF (undated).
Source: Roberto Schlatter and Luis A. Espinosa.
Criteria for inclusion: 123.

Caritaya Dam (2)

Location: 19°01'S, 69°19'W; 120 km southeast of Arica, Region I.
Area: 650 ha.
Altitude: 3,600m.
Province and type: 8.37.12; 15.
Site description: A small freshwater reservoir in the high Andes just southwest of Lauca National Park.
Principal vegetation: No information.
Land tenure: No information.
Protection: None.

Land use: No information.
Waterfowl: The most northerly known breeding locality of the Horned Coot *Fulica cornuta*; three nests were found in 1957.
Other fauna: No information.
Threats: No information.
References: McFarlane (1975b).
Source: See references.
Criteria for inclusion: 2a.

Wetlands in Isluga National Park (3)

Location: 19°15'S, 68°44'W; 80 km east of Huara, Region I.
Area: Several thousand hectares of wetlands.
Altitude: 4,500m.
Province and type: 8.36.12/8.37.12; 10, 12, 14 & 19.
Site description: Permanent fresh, brackish and saline lakes, wet Andean meadowland (bofedales), and fast flowing rivers and streams on a high Andean plateau. The area includes several thousand hectares of the vast Salar de Coipasa on the Bolivian border, but there are no large freshwater lakes.
Principal vegetation: Similar to Lauca National Park.
Land tenure: State owned (fiscal).
Protection: In the Isluga National Park (400,000 ha).
Land use: No information.
Waterfowl: Presumably similar to that of Lauca National Park.
Other fauna: No information.
Threats: No information.
Source: Roberto Schlatter and Luis A. Espinosa.
Criteria for inclusion: 0.

Salar de Huasco (4)

Location: 20°18'S, 68°52'W; 135 km east of Iquique, Region I.
Area: 6,000 ha.
Altitude: 4,000m.
Province and type: 8.37.12; 14 & 19.
Site description: High Andean salt basin inundated by summer rains, with nearby snow melt bogs and bofedales.
Principal vegetation: Bofedal and Andean steppe vegetation (see Lauca National Park).
Land tenure: Private and/or public ownership.
Protection: None.
Land use: No information.
Waterfowl: Presumably similar to Lauca National Park; the Andean Flamingo *Phoenicoparrus andinus* is reported to have bred.
Other fauna: No information.
Threats: No information.
References: Kahl (1975).
Source: Roberto Schlatter and Luis A. Espinosa.
Criteria for inclusion: 0.

Salar de Ascotan (5)

Location: 21°30'S, 68°18'W; 240 km southwest of Iquique, Region II.
Area: 37,800 ha salar with numerous small lakes totalling 325 ha.
Altitude: 3,722m.

Province and type: 8.37.12; 14 & 19.
Site description: High Andean salt basin inundated by summer storms and with a number of highly saline lakes around its perimeter; and nearby snow melt bogs and bofedales.
Principal vegetation: Bofedal and Andean steppe vegetation (see Lauca National Park).
Land tenure: Private and/or public ownership.
Protection: None.
Land use: No information.
Waterfowl: Important for flamingos: up to 250 *Phoenicoparrus jamesi* have been observed, and *P. andinus* is reported to have bred.
Other fauna: No information.
Threats: No information.
References: Kahl (1975); Hurlbert (1978).
Source: Roberto Schlatter and Luis A. Espinosa.
Criteria for inclusion: 0.

Salar de Atacama (6)

Location: 23°25'S, 68°20'W; 200 km east of Antofagasta, Region II.
Area: 280,000 ha.
Altitude: 2,300m.
Province and type: 8.37.12; 14 & 19.
Site description: High Andean salt basin with many small saline lakes inundated by summer storms, and nearby snow melt bogs and bofedales.
Principal vegetation: Bofedal and Andean steppe vegetation (see Lauca National Park).
Land tenure: Public and/or private ownership.
Protection: None.
Land use: No information.
Waterfowl: The principal and perhaps only regular breeding site of the Andean Flamingo *Phoenicoparrus andinus.* The other two Andean flamingos *P. jamesi* and *Phoenicopterus chilensis* occur as nonbreeding visitors in small numbers.
Other fauna: No information.
Threats: New roads have provided easier access to flamingo nesting areas and the collection of eggs for human consumption is becoming a serious problem.
Research and conservation: Studies are underway for the establishment of one or more protected areas by CONAF in collaboration with the New York Zoological Society.
References: Hurlbert (1978, 1981 & 1982).
Source: Roberto Schlatter and Luis A. Espinosa.
Criteria for inclusion: 1c.

Salares de Aguas Calientes and Lagunas de Miscanti (7)

Location: 23°00'-24°00'S, 67°08'-67°48'W; 300 km east of Antofagasta, Region II.
Area: Approximately 100,000 ha of wetlands.
Altitude: 4,150-4,550m.
Province and type: 8.37.12; 14 & 19.
Site description: A complex of high Andean salt basins and salt lakes inundated by summer storms, with nearby snow melt bogs and bofedales. The principal wetlands are as follows:

Salar de Tara: 3,500 ha open water, 4,325m
Salar de Pujsa: 600 ha open water, 4,525m
Salar de Quisquiro: 7,000 ha salar with 400 ha open water, 4,185m
Salar de Aguas Calientes I: 12,000 ha salar with 500 ha open water, 4,211m
Laguna Lejia: 210 ha, 4,325m
Salar de Aguas Calientes II: 500 ha open water, 4,195m
Laguna de Miscanti: 1,400 ha, c.4,250m.

All are hypersaline, and the Salar de Pujsa has permanent ice islands.
Principal vegetation: Bofedal and Andean steppe vegetation (see Lauca National Park).

Land tenure: Private and/or public ownership.
Protection: None.
Land use: No information.
Waterfowl: An important feeding and nesting area for flamingos: up to 5,000 flamingos have been observed at one time, and up to 2,500 *Phoenicoparrus jamesi*, 730 *P. andinus* and 310 *Phoenicopterus chilensis* have been identified. *P. jamesi* has probably bred at Salar de Tara, and *P. chilensis* is known to have bred at Salar de Pujsa and at Salar de Quisquiro.
Other fauna: No information.
Threats: None known.
References: Hurlbert (1978, 1981 & 1982); Hurlbert & Chang (1984).
Source: Roberto Schlatter and Luis A. Espinosa.
Criteria for inclusion: 1b & 3b.

Salar de Aguas Calientes III (8)

Location: 25°00'S, 68°38'W; 190 km ENE of Taltal, Region II.
Area: 1,400 ha.
Altitude: 3,670m.
Province and type: 8.37.12; 14 & 19.
Site description: High Andean salt lake with permanent ice islands, and nearby bofedales.
Principal vegetation: Bofedal and Andean steppe vegetation.
Land tenure: No information.
Protection: None.
Land use: No information.
Waterfowl: An important feeding area for flamingos: up to 760 *Phoenicoparrus andinus* and 150 *Phoenicopterus chilensis* have been recorded, with much smaller numbers of *Phoenicoparrus jamesi.*
Other fauna: No information.
Threats: No information.
References: Hurlbert (1978 & 1981); Hurlbert & Chang (1984).
Source: See references.
Criteria for inclusion: 1b.

Lagunas Brava, del Jilquero, Escondida and Verde, Salar de Piedra Parada and Salar de Pedernales (9)

Location: 25°40'-27°00'S, 68°25'-69°15'W; 180 km east of Chanaral, Region III.
Area: c.100,000 ha of wetlands.
Altitude: 3,500-4,250m.
Province and type: 8.37.12; 14 & 19.
Site description: High Andean salt basins and salt lakes inundated by summer storms, with nearby snow melt bogs and bofedales.
Principal vegetation: Bofedal and Andean steppe vegetation.
Land tenure: Private and/or public ownership.
Protection: None.
Land use: No information.
Waterfowl: All three Andean species of flamingos are known to occur; this is the most southerly locality for *Phoenicoparrus jamesi* in the Andes.
Other fauna: No information.
Threats: No information.
References: Hurlbert *et al* (1976); Hurlbert (1978); Hurlbert & Keith (1979).
Source: Roberto Schlatter and Luis A. Espinosa.
Criteria for inclusion: 0.

Laguna Santa Rosa and Lago del Negro Francisco (10)

Location: 27°05'-28°00'S, 69°10'-69°13'W; 170 km east of Caldera, Region III.
Area: 3,000 ha.
Altitude: Santa Rosa 3,760m; Negro Francisco 4,000m.
Province and type: 8.37.12; 14 & 19.
Site description: Four permanent high Andean mixosaline lakes with surrounding bofedales. Laguna Santa Rosa consists of three small lakes totalling 70 ha in extent; Lago del Negro Francisco is a large lake of about 2,800 ha.
Principal vegetation: There is a limited growth of *Ruppia filifolia* in Laguna Santa Rosa. Surrounding areas have typical bofedal and Andean steppe vegetation.
Land tenure: Private and/or public ownership.
Protection: None.
Land use: No information.
Waterfowl: Laguna Santa Rosa is an important breeding area for *Fulica cornuta*; some 100 birds and 30 nests were found there in 1956. Small numbers of the flamingos *Phoenicopterus chilensis* and *Phoenicoparrus andinus* have been observed.
Other fauna: No information.
Threats: No information.
References: Johnson (1965); Hurlbert (1978).
Source: Roberto Schlatter and Luis A. Espinosa.
Criteria for inclusion: 2a.

Caleta Vitor (11)

Location: 18°44'S, 70°19'W; 30 km south of Arica, Region I.
Area: 500 ha.
Altitude: 0m.
Province and type: 8.24.7; 01, 02, 04, 05 & 09.
Site description: Coast of sea bay with rocky and sandy shores, coastal sand dunes and estuary of the Rio Vitor.
Principal vegetation: Some marsh vegetation at the mouth of the river including species of *Scirpus*, *Phragmites*, and *Typha*.
Land tenure: Private and/or public ownership.
Protection: None.
Land use: No information.
Waterfowl: An important area for migrant shorebirds and Laridae.
Other fauna: No information.
Threats: Pollution from nearby towns.
Source: Roberto Schlatter and Luis A. Espinosa.
Criteria for inclusion: 0.

Caleta Camarones (12)

Location: 19°12'S, 70°17'W; 75 km south of Arica, Region I.
Area: 500 ha.
Altitude: 0m.
Province and type: 8.24.7; 01, 02, 04, 05 & 09.
Site description: Coast of sea bay with rocky and sandy shores, coastal sand dunes and estuary of the Rio Camarones.
Principal vegetation: Some marsh vegetation near the river mouth including species of *Scirpus*, *Typha* and *Phragmites*.
Land tenure: Private and/or public ownership.
Protection: None.
Land use: No information.
Waterfowl: An important area for migrant shorebirds and Laridae.

Other fauna: No information.
Threats: None known.
Source: Roberto Schlatter and Luis A. Espinosa.
Criteria for inclusion: 3a.

Caleta Loa (13)

Location: 21°25'S, 70°04'W; 130 km south of Iquique, Region II.
Area: 500 ha.
Altitude: 0m.
Province and type: 8.24.7; 01, 02, 04, 05 & 09.
Site description: Coast of sea bay with rocky and sandy shores, coastal sand dunes, and estuary of the Rio Loa.
Principal vegetation: Some marsh vegetation at river mouth including species of *Scirpus*, *Typha* and *Phragmites*.
Land tenure: Private and/or public ownership.
Protection: None.
Land use: No information.
Waterfowl: An important area for migrant shorebirds and Laridae.
Other fauna: No information.
Threats: None known.
Source: Roberto Schlatter and Luis A. Espinosa.
Criteria for inclusion: 3a.

Peninsula de Mejillones (14)

Location: 23°03'S, 70°27'W; between Antofagasta and Mejillones, Region II.
Area: 2,500 ha.
Altitude: 0m.
Province and type: 8.24.7; 01, 03, 04, 05 & 06.
Site description: The Mejillones Peninsula (50 km x 20 km) with rocky sea coast, sea cliffs and rocky offshore islets, and the two large sea bays, Bahia Mejillones del Sur and Bahia de San Jorge, to the north and south of the peninsula respectively, with extensive intertidal sand flats, sandy beaches and coastal sand dunes.
Principal vegetation: Some marine algae in the intertidal zone. In the desertic coastal scrub (matorral) and cactus zone.
Land tenure: State owned.
Protection: None.
Land use: Commercial and traditional fishing and fishmeal industry, with mining and chemical industries on the nearby coast.
Waterfowl: The most important "wintering" area for Nearctic shorebirds along the northern coast of Chile, and a very important breeding area for Humboldt current sea-birds. The two bays are particularly important for feeding *Larus modestus* which has declined greatly in numbers in recent years due to the loss of nesting sites in the coastal desert.
Other fauna: The marine otter *Lutra felina*, the sea-lion *Otaria flavescens* and the fur sea *Arctocephalus australis* occur.
Threats: Pollution from the chemical and fishing industries, overfishing, and disturbance from fishermen, tourism and guano collectors.
Research and conservation: A considerable amount of research has been conducted in the area by Carlos Guerra and others, particularly on *Larus modestus* and *Arctocephalus australis*.
References: Zarate (1983); many publications by Guerra *et al* (1981-1983 and in prep).
Source: Carlos G. Guerra, Roberto Schlatter and Luis A. Espinosa.
Criteria for inclusion: 123.

Taltal Bay (15)

Location: 25°23'S, 70°31'W; 4 km west of Taltal, Region II.
Area: 400 ha.
Altitude: 0m.
Province and type: 8.24.7; 01, 02 & 05.
Site description: A sea bay with sandy beaches, coastal sand dunes and estuary of the Quebrada Taltal.
Principal vegetation: In desertic coastal scrub and cactus zone.
Land tenure: Private and/or public ownership.
Protection: None.
Land use: No information.
Waterfowl: An important area for migrant shorebirds and Laridae.
Other fauna: No information.
Threats: None known.
Source: Roberto Schlatter and Luis A. Espinosa.
Criteria for inclusion: 0.

Bahia Chañaral (16)

Location: 26°21'S, 70°37'W; near Chañaral town, Region III.
Area: 400 ha.
Altitude: 0m.
Province and type: 8.24.7; 01, 02 & 05.
Site description: A sea bay with sandy beaches, coastal sand dunes and estuary of the Quebrada del Salado.
Principal vegetation: In desertic coastal scrub and cactus zone.
Land tenure: Private and/or public ownership.
Protection: None.
Land use: No information.
Waterfowl: An important area for migratory shorebirds and Laridae.
Other fauna: No information.
Threats: Pollution with chemical products.
Source: Roberto Schlatter and Luis A. Espinosa.
Criteria for inclusion: 0.

Coast between Huasco and Carrizal (17)

Location: 28°04'-28°28'S, 71°10'W; 50 km northwest of Vallenar, Regions III and IV.
Area: c. 2,000 ha (50 km of sea coast).
Altitude: 0m.
Province and type: 8.24.7; 01, 02 & 05.
Site description: 50 kilometres of sea coast with several small bays with sandy beaches and coastal sand dunes, and three small estuaries.
Principal vegetation: In semi-desertic coastal scrub and woodland zone.
Land tenure: Private and/or public ownership.
Protection: None.
Land use: No information.
Waterfowl: An important area for shorebirds and Laridae.
Other fauna: No information.
Threats: Pollution from mining activities and industrial waste.
Source: Roberto Schlatter and Luis A. Espinosa.
Criteria for inclusion: 0.

Bahia de Coquimbo (18)

Location: 29°53'S, 71°19'W; north of Coquimbo town, Region IV.
Area: 2,040 ha.
Altitude: 0m.
Province and type: 8.24.7; 01, 02 & 05.
Site description: A sea bay and estuary with sandy beaches and coastal sand dunes.
Principal vegetation: In semi-desertic coastal scrub and woodland zone.
Land tenure: Private and/or public ownership.
Protection: None.
Land use: No information.
Waterfowl: An important area for shorebirds and Laridae.
Other fauna: No information.
Threats: None known.
Source: Roberto Schlatter and Luis A. Espinosa.
Criteria for inclusion: 0.

Embalse La Paloma and Embalse Recoleta (19)

Location: 30°50'S, 71°12'W; near Ovalle, Region IV.
Area: La Paloma 2,000 ha; Recoleta 500 ha.
Altitude: 500m.
Province and type: 8.37.12; 10 & 15.
Site description: Two freshwater reservoirs with some fringing marshes, and associated fast-flowing rivers and streams with some riverine forest.
Principal vegetation: Marshes with species of *Scirpus, Phragmites* and *Typha.*
Land tenure: Public and/or private ownership.
Protection: None.
Land use: No information.
Waterfowl: An important area for Anatidae.
Other fauna: No information.
Threats: None known.
Source: Roberto Schlatter and Luis A. Espinosa.
Criteria for inclusion: 0.

Wetlands in Lago Peñuelas Forest Reserve (20)

Location: 33°10'S, 71°32'W; near Quilpue, Region V.
Area: c.3,000 ha of wetlands.
Altitude: 335m.
Province and type: 8.23.6; 10, 12 & 16.
Site description: A permanent freshwater lake (Lago Peñuelas) and associated marshes, fast-flowing streams and some seasonally inundated grassland.
Principal vegetation: In an area of thorn-bush savanna with plantations of introduced tree species.
Land tenure: State owned (fiscal).
Protection: Within the Lago Peñuelas Forest Reserve (9,095 ha) established in 1981.
Land use: No information.
Waterfowl: An important area for Anatidae.
Other fauna: No information.
Threats: None known.
References: Rottman & Glade (1973); Drouilly & Ibarra (1978).
Source: Roberto Schlatter and Luis A. Espinosa.
Criteria for inclusion: 0.

Laguna El Peral (21)

Location: 33°30'S, 71°38'W; 50 km south of Valparaiso, Region V.
Area: 16 ha.
Altitude: 0m.
Province and type: 8.23.6; 12.
Site description: A small permanent freshwater lake and associated marshes.
Principal vegetation: Marshes with species of *Scirpus*, *Phragmites* and *Typha*.
Land tenure: State owned (Ministry of Education).
Protection: A Nature Sanctuary.
Land use: Some tourist recreation on nearby beaches.
Waterfowl: A wide variety of waterfowl occur, including *Cygnus melancoryphus*, and species of ducks Anatidae, grebes Podicipedidae and herons Ardeidae.
Other fauna: No information.
Threats: Disturbance from tourism causes some problems.
References: Gonzalez (1975); Schlatter (1975); Riveros *et al* (1981).
Source: Roberto Schlatter and Luis A. Espinosa.
Criteria for inclusion: 2b & 3a.

El Convento and Estero Yali (22)

Location: 33°48'S, 71°46'W; 20 km SSW of San Antonio, Region V.
Area: 8,450 ha.
Altitude: 0-5m.
Province and type: 8.23.6; 02, 05, 06, 07, 09 & 11.
Site description: An estuarine system with a slow-flowing river, riverine marshes, wet meadows, fresh to brackish lagoons and marshes, intertidal mudflats and sandy beaches.
Principal vegetation: Marshes with species of *Scirpus*, *Typha* and *Phragmites*.
Land tenure: Private and/or public ownership.
Protection: None.
Land use: No information.
Waterfowl: An important wetland area for a wide variety of waterfowl including Anatidae and migratory shorebirds.
Other fauna: No information.
Threats: Some illegal hunting causes problems.
References: Johnson & Ewer (1969).
Source: Roberto Schlatter and Luis A. Espinosa.
Criteria for inclusion: 2b & 3a.

Laguna Torca (23)

Location: 34°46'S, 72°03'W; 80 km northwest of Talca, Region VI.
Area: 170 ha.
Altitude: 0m.
Province and type: 8.23.6; 07.
Site description: A permanent coastal brackish lake with associated fresh to brackish marshes.
Principal vegetation: Marshes with species of *Scirpus*, *Phragmites* and *Typha*.
Land tenure: State owned (Ministry of Education).
Protection: A Nature Sanctuary.
Land use: Tourism; there are plantations of exotic pines nearby.
Waterfowl: A variety of waterfowl including *Cygnus melancoryphus*, *Plegadis chihi* and various grebes, herons and ducks.
Other fauna: No information.
Threats: Disturbance from tourism and the exploitation of timber.

References: Drouilly (1969); Gonzalez (1977).
Source: Roberto Schlatter and Luis A. Espinosa.
Criteria for inclusion: 2b & 3a.

Laguna del Maule (24)

Location: 36°04'S, 70°30'W; 120 km southeast of Talca, Region VII.
Area: 16,800 ha.
Altitude: 2,900m.
Province and type: 8.37.12; 10, 12 & 19.
Site description: A large permanent freshwater Andean lake and associated fast-flowing rivers, marshes and snow melt bogs.
Principal vegetation: In a region of high Andean steppe.
Land tenure: Private and/or public ownership.
Protection: None.
Land use: No information.
Waterfowl: No information.
Other fauna: No information.
Threats: No information.
References: Drouilly & Montecinos (1976).
Source: Roberto Schlatter and Luis A. Espinosa.
Criteria for inclusion: 0.

Rio Itata Estuary (25)

Location: 36°24'S, 72°51'W; 50 km NNE of Concepcion, Region VIII.
Area: 2,550 ha.
Altitude: 0m.
Province and type: 8.22.5; 02, 07, 09, 11, 16 & 19.
Site description: The estuarine system of the Rio Itata, with riverine marshes, seasonally flooded grassland, peat bogs and coastal brackish to saline marshes.
Principal vegetation: In a region of coastal scrub and woodland, with some sparsely vegetated sandy areas.
Land tenure: Private and/or public ownership.
Protection: None.
Land use: No information.
Waterfowl: No information.
Other fauna: No information.
Threats: No information.
Source: Roberto Schlatter and Luis A. Espinosa.
Criteria for inclusion: 0.

Hualpen Peninsula (26)

Location: 36°40'S, 73°07'W; north of Talcahuano, Region VIII.
Area: 1,000 ha.
Altitude: 0-50m.
Province and type: 8.22.5; 01, 04, 05, 13 & 16.
Site description: A sea bay and peninsula with rocky and sandy shores; with freshwater marshes and seasonally flooded grassland inland.
Principal vegetation: Marshes with species of *Scirpus*, *Phragmites* and *Typha*.
Land tenure: State owned (Ministry of Education).
Protection: A Nature Sanctuary.
Land use: No information.

Waterfowl: An important area for migratory Anatidae and shorebirds.
Other fauna: No information.
Threats: None known.
References: Jorge Juan (1976).
Source: Roberto Schlatter and Luis A. Espinosa.
Criteria for inclusion: 2b & 3a.

Bahia Arauco (27)

Location: 37°14'S, 73°25'W; 55 km southwest of Concepcion, Region VIII.
Area: 5,250 ha.
Altitude: 0m.
Province and type: 8.22.5; 01, 02, 04, 05, 09 & 11.
Site description: A large sea bay and estuary with rocky and sandy shores, coastal sand dunes, and slow-flowing river and associated riverine marshes.
Principal vegetation: In an area of coastal woodland and sand dunes.
Land tenure: No information.
Protection: None.
Land use: No information.
Waterfowl: An important area for migratory Anatidae and shorebirds.
Other fauna: No information.
Threats: Pollution from iron and coal industries on the coast.
References: Jorge Juan (1976).
Source: Roberto Schlatter and Luis A. Espinosa.
Criteria for inclusion: 0.

Wetlands in Laguna del Laja National Park (28)

Location: 37°21'S, 71°19'W; 160 km ESE of Concepcion, Region VIII.
Area: Laguna del Laja 10,440 ha.
Altitude: 1,000m.
Province and type: 8.37.12; 10, 12 & 19.
Site description: A large permanent freshwater lake with some marshes, fast-flowing mountain rivers and streams, and bogs fed by snow melt.
Principal vegetation: In a region of Andean steppe dominated by *Festuca* spp.
Land tenure: State owned (fiscal).
Protection: Within the Laguna del Laja National Park (11,600 ha).
Land use: No information.
Waterfowl: No information.
Other fauna: No information.
Threats: None known.
Source: Roberto Schlatter and Luis A. Espinosa.
Criteria for inclusion: 0.

Paicavi Estuary and Lago Lleu-Lleu (29)

Location: 38°10'S, 73°20'W; 180 km north of Valdivia, Region VIII.
Area: 26,250 ha.
Altitude: 0-10m.
Province and type: 8.22.5; 02, 05, 09 & 12.
Site description: An estuarine system with sandy beaches and coastal sand dunes, a slow-flowing river with associated marshes, and a large freshwater lake and marshes.
Principal vegetation: In a region of coastal woodland and sand dune vegetation.
Land tenure: Private and/or public ownership.

Protection: None.
Land use: No information.
Waterfowl: No information.
Other fauna: No information.
Threats: No information.
Source: Roberto Schlatter and Luis A. Espinosa.
Criteria for inclusion: 0.

Lago Budi (30)

Location: 38°53'S, 73°18'W; 100 km north of Valdivia, Region IX.
Area: 14,400 ha.
Altitude: 0m.
Province and type: 8.10.2; 02, 05, 06, 07, 09 & 11.
Site description: An estuarine system with sandy beaches, intertidal mudflats, brackish to saline coastal lagoons and marshes, coastal sand dunes, and slow-flowing river with riverine marshes.
Principal vegetation: Marshes with species of *Scirpus*, *Typha* and *Phragmites*.
Land tenure: Private and/or public ownership.
Protection: None.
Land use: Adjacent areas are under cultivation.
Waterfowl: An important area for Anatidae.
Other fauna: No information.
Threats: Excessive hunting, both legal and illegal; expansion of agriculture.
References: SAG (1981).
Source: Roberto Schlatter and Luis A. Espinosa.
Criteria for inclusion: 0.

Bahia Queule and Rio Queule (31)

Location: 39°23'S, 73°12'W; 50 km north of Valdivia, Region IX.
Area: 2,100 ha.
Altitude: 0m.
Province and type: 8.10.2; 01, 02, 05, 09 & 11.
Site description: Sea bay and estuarine system of the Rio Queule, with sandy beaches, coastal sand dunes and riverine marshes.
Principal vegetation: No information.
Land tenure: Private and/or public ownership.
Protection: None.
Land use: Traditional fishing.
Waterfowl: An important area for shorebirds.
Other fauna: No information.
Threats: None known.
Source: Roberto Schlatter and Luis A. Espinosa.
Criteria for inclusion: 0.

Rio Cruces and Carlos Anwandter Sanctuary (32)

Location: 39°47'S, 73°16'W; north of Valdivia city, Region X.
Area: 4,877 ha.
Altitude: 0-2m.
Province and type: 8.10.2; 09, 10, 11 & 16.
Site description: A complex of rivers and streams with sandbars and islands, associated riverine marshes and seasonally inundated grasslands in a depression caused by subsidence during an earthquake in 1960. Water levels rise by up to 1m during periods of flooding.

Principal vegetation: Marshes with *Sagittaria chilensis, Scirpus californicus, Hydrootyle volksmanni, Typha angustifolia, Phragmites* sp, *Senecio* spp, *Juncus* spp and sedges Cyperaceae. In a region of Valdiviano woodland.
Land tenure: State owned (Ministry of Education).
Protection: Protected in the Carlos Anwandter Nature and Scientific Investigation Sanctuary. Designated as a Ramsar site in 1981; the only Ramsar site in Chile.
Land use: Nature tourism and research.
Waterfowl: An important area for Anatidae including *Cygnus melancoryphus*, Podicipedidae and Ardeidae.
Other fauna: The Osprey *Pandion haliaetus* is a regular non-breeding visitor.
Threats: Some pollution from run-off of pesticides from nearby agricultural land.
Research and conservation: The wetland is managed as a field study area for the Universidad Austral de Chile.
References: Schlatter (1976b); Durrschmidt (1980); Schlatter & Morales (1980); IUCN (1982 & 1984).
Source: Roberto Schlatter and Luis A. Espinosa.
Criteria for inclusion: 2b & 3a.

Rio Rahue (33)

Location: 40°27'S, 73°16'W; 20 km northwest of Osorno, Region X.
Area: 9,000 ha.
Altitude: 50m.
Province and type: 8.10.2; 10, 11 & 18.
Site description: A complex of fast-flowing rivers and streams, and associated marshes and swamp forest.
Principal vegetation: In a region of Valdiviano forest.
Land tenure: Private and/or public ownership.
Protection: None.
Land use: Forestry.
Waterfowl: No information.
Other fauna: No information.
Threats: Excessive hunting is reported to be a problem.
References: Schlatter *et al* (1983).
Source: Roberto Schlatter and Luis A. Espinosa.
Criteria for inclusion: 0.

The Chilean Lake District (34)

Location: 38°22'-41°20'S, 71°15'-73°00'W; Regions IX and X.
Area: c.300,000 ha of lakes and associated marshes.
Altitude: mainly 100-1,000m; most of the large lakes are below 300m.
Province and type: 8.10.2/8.22.5/8.37.12; 10, 11, 12, 16, 18 & 19.
Site description: A chain of large, permanent, deep, freshwater lakes in the foothills of the southern Andes stretching from Temuco in the north to the region of Puerto Montt in the south. The principal lakes are Lago Colico (5,400 ha), Lago Villarrica (19,000 ha), Lago Calafquen (15,000 ha), Lago Ranguipulli (15,000 ha), Lago Rinihue (9,250 ha), Lago Pirehueico (3,200 ha), Lago Ranco (44,000 ha), Lago Maihue (4,750 ha), Lago Puyehue (17,000 ha), Lago Rupanco (25,000 ha), Lago Todos los Santos (21,000 ha), Lago Llanquihue (85,000 ha) and Lago Chapo (4,900 ha). The region abounds in fast-flowing rivers and streams, and there are numerous small freshwater lakes, marshes and bogs at higher elevations in the Andes.
Most of the large lakes in the lowlands are much disturbed and of little importance for wildlife. Of the lakes listed above, only Todos los Santos lies within a Protected Area. Areas thought to be of special importance are treated separately below.

Wetlands in Conguillio y Los Paraguas National Park (34a)

Location: 38°22'S, 71°38'W; 20 km ENE of Curacautin, Region IX.
Area: 16,000 ha.
Altitude: 1,200m.
Province and type: 8.22.5/8.37.12; 10, 12 & 19.
Site description: Three large deep freshwater lakes (Lago Conguillio, Laguna Verde and Laguna Captren) with some associated marshes, a fast flowing river (Rio Truful-Truful) and tributaries, and Andean bogs fed by snow melt in a region of volcanic activity.
Principal vegetation: In a region of *Nothofagus* forest with some *Araucaria araucana*, and Andean-Patagonian steppe.
Land tenure: Mainly state owned (fiscal), with some private holdings.
Protection: Within the Conguillio y Los Paraguas National Park (58,000 ha) established in 1940.
Land use: Tourism in both summer and winter.
Waterfowl: A variety of breeding species including Podicipedidae, *Chloephaga* spp, *Fulica* spp and *Larus serranus*.
Other fauna: No information.
Threats: There is some disturbance in the park from neighbouring properties.
Research and conservation: A management plan for the park has been prepared by CONAF.
References: CONAF & FAO (1974); IUCN (1982).
Source: Roberto Schlatter and Luis A. Espinosa.
Criteria for inclusion: 3a.

Wetlands in Alto Bio-Bio Forest Reserve (34b)

Location: 38°42'S, 71°16'W; Araucania, Region IX.
Area: 7,000 ha of wetlands.
Altitude: 2,000m.
Province and type: 8.22.5/8.37.12; 10 & 12.
Site description: Freshwater lakes and marshes, and fast-flowing rivers and streams.
Principal vegetation: In region of mountain forests of *Araucaria* and Andean-Patagonian steppe.
Land tenure: State owned (fiscal).
Protection: Within the Alto Bio-Bio Forest Reserve (35,190 ha) established in 1981.
Land use: Forestry.
Waterfowl: No information.
Other fauna: No information.
Threats: None known.
Source: Roberto Schlatter and Luis A. Espinosa.
Criteria for inclusion: 3a.

Wetlands in Villarrica National Park (34c)

Location: 39°25'S, 72°00'W; 50 km east of Loncoche, Region IX.
Area: 21,000 ha of wetlands.
Altitude: 900m.
Province and type: 8.37.12; 10, 12 & 19.
Site description: Permanent freshwater lakes and marshes, fast-flowing mountain rivers and streams, and high Andean bogs fed by snow melt in a region of volcanic activity.
Principal vegetation: In a region of *Nothofagus* and *Araucaria* forest and Andean grassland.
Land tenure: State owned (fiscal).
Protection: Within the Villarrica National Park (65,400 ha) established in 1940.
Land use: Tourism in the National Park.
Waterfowl: No information.
Other fauna: No information.
Threats: Forest fires and illegal settlers cause some problems in the park.
Research and conservation: A management plan for the National Park has been produced.

References: Castro *et al* (1974); IUCN (1982).
Source: Roberto Schlatter and Luis A. Espinosa.
Criteria for inclusion: 3a.

Wetlands in the Puyehue and Vicente Perez Rosales National Parks (34d)

Location: 40°40'-41°06'S, 72°15'-72°30'W; 60 km east of Osorno, Region X.
Area: 45,000 ha of wetlands.
Altitude: 200-500m.
Province and type: 8.10.2/8.37.12; 10, 12, 16 & 19.
Site description: A large freshwater lake of 12,500 ha (Lago Todos los Santos), its associated marshes, fast-flowing mountain rivers and streams, riverine marshes, seasonally flooded meadows, and Andean bogs fed by snow melt in a region of volcanic activity. The most extensive marshes are at the mouths of rivers entering the lake. The lake is probably several hundred metres deep.
Principal vegetation: Wet meadows and delta marshes with *Phragmites communis, Holcus lantus, Plantago lanceolata, Hydrocotyle poepeggie, Juncus leseurii* and *Rumex* sp. In a region of Valdiviano rain forest (lower slopes), and *Nothofagus* forest and Andean steppe (higher elevations).
Land tenure: Mainly state owned (fiscal), with some private holdings.
Protection: Within two contiguous National Parks: Puyehue National Park (104,017 ha) established 1941, and Vicente Perez Rosales National Park (220,000 ha) established 1926.
Land use: Tourism in the National Parks. There is a regular passenger boat service across the lake.
Waterfowl: An important area for waterfowl with large populations of several species, notably *Podiceps major* and *Chloephaga poliocephala.*
Other fauna: The Southern River Otter *Lutra provocax* and the Coypu *Myocastor coypus* occur.
Threats: There is some disturbance from tourism and the private inholdings in the parks. The National Electricity Corporation (ENDESA) has included Lago Todos los Santos in its hydroelectric development plans. Development of the lake is scheduled for initiation in 1986, and will involve the construction of a low barrage at the lake's outlet to raise the water level. This is likely to result in severe shoreline erosion and will change flooding patterns in marshes at river deltas (W.E. Klohn, pers. com. to WWF/IUCN).
Research and conservation: Very few studies have been conducted in the parks other than preliminary inventories of the fauna and flora. The Park is managed by CONAF, and there is a small visitor centre and museum at Petrohue.
References: Greenquist (1982); IUCN (1982).
Source: Roberto Schlatter and Luis A. Espinosa.
Criteria for inclusion: 2a, 2b & 3a.

Reloncavi Estuary (35)

Location: 41°40'S, 72°21W; 40 km southeast of Puerto Montt, Region X.
Area: 28,000 ha.
Altitude: 0m.
Province and type: 8.10.2; 02, 04, 05, 06, 07, 10 & 11.
Site description: The estuarine system of the Rio Reloncavi, with rocky and sandy beaches, intertidal mudflats, salt marshes, riverine marshes and wet meadows.
Principal vegetation: In a region of *Nothofagus* forest.
Land tenure: Private and/or public ownership.
Protection: None.
Land use: Traditional fishing and exploitation of algae.
Waterfowl: An important wintering area for Anatidae and shorebirds.
Other fauna: No information.

Threats: Increased human settlement, overfishing and over-exploitation of the marine algae.
Source: Roberto Schlatter and Luis A. Espinosa.
Criteria for inclusion: 0.

Wetlands in Alerce Andino National Park (36)

Location: 41°27'S, 72°30'W; 40 km east of Puerto Montt, Region X.
Area: 2,200 ha.
Altitude: 0-350m.
Province and type: 8.10.2; 02, 04, 06, 07, 09, 12 & 19.
Site description: Estuarine coast with rocky shores, intertidal mudflats and salt marshes; small freshwater lakes and marshes; fast-flowing mountain streams; and Andean bogs; in a region of volcanic activity.
Principal vegetation: In a region of *Nothofagus* and *Fitzroya* forest with some Mirtaceae scrub at low elevations.
Land tenure: State owned (fiscal).
Protection: Within the newly created Alerce Andino National Park (39,225 ha).
Land use: National Park.
Waterfowl: No information.
Other fauna: No information.
Threats: None known.
Source: Roberto Schlatter and Luis A. Espinosa.
Criteria for inclusion: 0.

Isla Coihuin - Pelluco (37)

Location: 41°29'S, 72°51'W; 5 km east of Puerto Montt, Region X.
Area: 5,000 ha.
Altitude: 0m.
Province and type: 8.10.2; 01, 02, 05, 06, 07, 09, 11 & 16.
Site description: Sea bay coast with sandy beaches and coastal sand dunes; small estuarine system with intertidal mudflats and salt marshes; and river with riverine marshes, wet meadows and seasonally flooded grassland.
Principal vegetation: Marshes with *Scirpus*, *Typha* and *Phragmites*.
Land tenure: Private and/or public ownership.
Protection: None.
Land use: Traditional fishing and exploitation of algae.
Waterfowl: An important area for shorebirds and Laridae including Nearctic migrants (*Limosa haemastica*, *Numenius phaeopus* and *Larus pipixcan*).
Other fauna: No information.
Threats: Over-exploitation of the marine algae.
Source: Roberto Schlatter, Luis A. Espinosa and Jon Fjeldsa.
Criteria for inclusion: 3a.

The Rio Quenuir and Rio Maullin Estuaries (38)

Location: 41°35'S, 73°40'W; 60 km west of Puerto Montt, Region X.
Area: 3,600 ha.
Altitude: 0m.
Province and type: 8.10.2; 01, 02, 05, 06, 07, 09, 11, 16 & 18.
Site description: Sea bay coast with sandy beaches and coastal sand dunes; estuarine system of the Rio Maullin with intertidal mudflats, brackish coastal lagoons and salt marshes; and the lower Rio Maullin with its associated riverine marshes, seasonally flooded grassland and swamp forest.

Principal vegetation: Marshes with *Scirpus*, *Typha* and *Phragmites*; in a region of *Nothofagus* forest.
Land tenure: Private and/or public ownership.
Protection: None.
Land use: Traditional fishing and exploitation of algae.
Waterfowl: No information.
Other fauna: No information.
Threats: Over-exploitation of the marine algae.
Source: Roberto Schlatter and Luis A. Espinosa.
Criteria for inclusion: 0.

Wetlands in Chiloe National Park (39)

Location: 42°40'S, 73°57'W; 90 km south of Ancud on Chiloe Island, Region X.
Area: 16,400 ha of wetlands.
Altitude: 0-800m.
Province and type: 8.10.2; 01, 03, 04, 05, 06, 12, 13 & 18.
Site description: Sea coast with small rocky offshore islands, rocky and sandy shores, coastal sand dunes and some intertidal mudflats; and inland freshwater lakes, marshes, bogs and swamp forest.
Principal vegetation: In a region of *Nothofagus* forest and Mirtaceae scrub.
Land tenure: State owned (fiscal).
Protection: Within the Chiloe National Park (43,057 ha).
Land use: No information.
Waterfowl: No information.
Other fauna: The Marine Otter *Lutra felina* and sea-lion *Otaria flavescens* occur.
Threats: None known.
Source: Roberto Schlatter and Luis A. Espinosa.
Criteria for inclusion: 2a & 3a.

Archipelago off Eastern Chiloe Island (40)

Location: 42°35'S, 73°30'W; archipelago east of Castro, Chiloe Island, Region X.
Area: 250,000 ha.
Altitude: 0-3m.
Province and type: 8.10.2; 01, 03, 04, 05, 06, 07, 12, 13, 18 & 19.
Site description: An archipelago of numerous islands and islets centered around Isla Quinchao, with rocky and sandy shores, coastal sand dunes, extensive intertidal mudflats and salt marshes. There are many small freshwater lakes, marshes, peat bogs and area of swamp forest on the larger islands.
Principal vegetation: No information.
Land tenure: Public and/or private ownership.
Protection: None.
Land use: No information.
Waterfowl: A very important area for waterfowl with a variety of breeding and non-breeding Anatidae and shorebirds, the latter including both Nearctic migrants (*Limosa haemastica*, *Numenius phaeopus* and *Tringa melanoleuca*) and migrants from the south (*Charadrius modestus*). *Phoenicopterus chilensis* also occurs as a non-breeding visitor.
Other fauna: The Marine Otter *Lutra felina* probably occurs.
Threats: None known.
Source: Roberto Schlatter and Luis A. Espinosa.
Criteria for inclusion: 1a & 3a.

Yelcho-Pumalin Delta (41)

Location: 42°58'S, 72°45'W; 170 km south of Puerto Montt, Region X.

Area: 109,350 ha.

Altitude: 0-3m.

Province and type: 8.10.2; 01, 02, 03, 05, 07 & 10.

Site description: Sea bay and delta marshes of the Rio Yelcho-Pumalin, with sandy beaches, tidal salt marshes and small offshore islands.

Principal vegetation: No information.

Land tenure: Private and/or public.

Protection: None.

Land use: No information.

Waterfowl: An important area for *Phoenicopterus chilensis*, Anatidae and shorebirds.

Other fauna: No information.

Threats: Construction of roads, excessive forest exploitation and increased human settlement.

Source: Roberto Schlatter and Luis A. Espinosa.

Criteria for inclusion: 0.

Guamblad Fjord and San Pedro Canal (42)

Location: 43°18'S, 73°50'W; at southeast tip of Chiloe Island, Region X.

Area: 9,720 ha.

Altitude: 0m.

Province and type: 8.10.2; 01, 02, 03, 05, 07, 09 & 11.

Site description: Sea coast and small estuaries with sandy beaches, brackish to saline marshes, small offshore islands and riverine marshes.

Principal vegetation: In a region of *Nothofagus* forest.

Land tenure: Private and/or public ownership.

Protection: None.

Land use: No information.

Waterfowl: No information.

Other fauna: No information.

Threats: None known.

Source: Roberto Schlatter and Luis A. Espinosa.

Criteria for inclusion: 0.

Wetlands in the Southern Andes (43)

Location: 43°56'-46°51'S, 71[40'-72[52'W; in the Southern Andes of Chile from 180 km NNE to 170 km SSE of Puerto Aisen, Regions X and XI.

Area: Over 300,000 ha of wetlands.

Altitude: 100-1,500m (mainly 500-1,000m).

Province and type: 8.37.12/8.10.2; 10, 12, 16, 18 & 19.

Site description: A chain of small to very large freshwater lakes and associated marshes stretching through the southern Andes of Chile from Lago Patena in the north to the vast Lago Buenos Aires in the south. There are numerous fast-flowing mountain rivers and streams and highland bogs throughout the region, and areas of seasonally flooded grassland, wet meadows and swamp forest.

Principal vegetation: In a region of *Nothofagus* forest and patagonian steppe.

Land tenure: State owned (fiscal). The Dos Lagunas Natural Monument is owned by the Ministry of Education.

Protection: Large portions of the region are protected in a network of Forest Reserves and National Parks as follows:

8,690 ha of wetlands in Lago Palena Forest Reserve (41,380 ha)
42,480 ha of wetlands in Puyuhuapi Forest Reserve (184,700 ha)
7,425 ha of wetlands in Rosselot National Park (67,500 ha)

6,800 ha of wetlands in Puerto Cisnes Forest Reserve (136,000 ha)
1,050 ha of wetlands in Lago Las Torres Forest Reserve (35,000 ha)
2,800 ha of wetlands in Rio Simpson National Park (41,160 ha)
10,000 ha of wetlands in Dos Lagunas Natural Monument (10,000 ha)
26,930 ha of wetlands in Cerro Castillo Forest Reserve (179,550 ha)
41,030 ha of wetlands including part of Lago Buenos Aires (160 km long) in Lago General Carrera Forest Reserve (178,400 ha)
3,100 ha of wetlands in Lago Jeinimeni Forest Reserve (38,700 ha)

Land use: No information.
Waterfowl: An abundant waterfowl fauna includes typical Southern Andean species such as *Podiceps major, Theristicus caudatus melanopis, Chloephaga poliocephala, C. picta, Anas specularis* and *Merganetta armata.*
Other fauna: No information.
Threats: No information.
Source: Roberto Schlatter and Luis A. Espinosa.
Criteria for inclusion: 2b & 3a.

The Chilean Fjordland (44)

Location: 44°40'-53°00'S, 72°30'-75°10'W; from the region of Puerto Aisen in the north to 100 km west of Punta Arenas in the south, Regions XI and XII.
Area: Approximately 5,500,000 ha of wetland habitat.
Altitude: 0-1,000m, but mainly below 300m.
Province and type: 8.10.2/8.11.2; 01, 02, 03, 04, 05, 06, 07, 10, 12, 13, 16, 18 & 19.
Site description: The fjord coastline and associated offshore islands of southern Chile stretching in a belt up to 220 km wide for over 1,000 km from the Golfo de Guafo in the north to the Straits of Magellan in the south. The coastline is mainly rocky, with some stretches of sandy beach, small estuaries with intertidal mudflats and salt marshes, and patches of coastal sand dunes. There are countless small islands in various archipelagos, many with high sea cliffs. Inland from the coast there are numerous freshwater lakes, marshes, peat bogs, fast-flowing rivers and streams, wet meadows, areas of seasonally flooded grassland and some swamp forest. On the higher ground and in the south there are extensive areas of tundra and bogs fed by melting glaciers and snow.
Principal vegetation: At lower elevations, humid forests of *Nothofagus* spp, *Tepualia stipularia, Laurelia* sp and *Pernettya* sp, and scrub with species of *Escalonia, Ribes* and *Gunnera*; at higher elevations, Magellanic pampa and Magellanic tundra.
Land tenure: Mainly state owned (fiscal).

Protection: Almost the entire region is included within a chain of National Parks and Forest Reserves as follows:
Isla Magdalena National Park (360,000 ha); an archipelago 80 km NNW of Puerto Aisen, containing 90,000 ha of wetlands.
Las Guaitecas Forest Reserve (850,000 ha); a large archipelago (Archipielago de Los Chonos) west of Puerto Aisen, containing over 550,000 ha of wetlands.
Isla Guamblin National Park (10,625 ha, established 1967); a remote and seldom visited island at the western edge of the Archipielago de Los Chonos, with 800 ha of wetlands.
Taitao Forest Reserve (915,000 ha); a region of fjord coastland and mountains 180 km southwest of Puerto Aisen, containing almost 500,000 ha of wetlands.
San Rafael National Park (1,350,000 ha, established 1959); a region of fjord coastland and mountains 200 km SSW of Puerto Aisen, containing 540,000 ha of wetlands. Included with Guayaneco National Park in a Biosphere Reserve (1,380,613 ha, established in 1979).
Guayaneco National Park (30,498 ha); a small archipelago 320 km southwest of Puerto Aisen, containing 18,300 ha of wetlands. Included with San Rafael National Park in a Biosphere Reserve.
Rio Pascua Forest Reserve (1,196,510 ha); a region of fjord coastland, islands and mountains south of the Golfo de Penas, containing nearly 900,000 ha of wetlands.

Alacalufes Forest Reserve (2,674,000 ha); a vast tract of fjordland and islands stretching from the Rio Pascua Forest Reserve to the entrance to the Straits of Magellan, and containing over 1,600,000 ha of wetlands.

O'Higgins, Torres del Paine and Monte Balmaceda National Parks (three contiguous National Parks totalling 1,930,000 ha); a region of fjord coastland and mountains stretching north from Puerto Natales for 350 km, and containing 965,000 ha of wetlands. The parks incorporate four large lakes; Lago O'Higgins, Lago Sarmiento, Lago del Toro and Lago Balmaceda. Torres del Paine National Park was established as a Biosphere Reserve of 163,000 ha in 1978.

Isla Riesco Forest Reserve (303,750 ha); a large island on the north shore of the Straits of Magellan 100 km west of Punta Arenas, containing 164,000 ha of wetlands including Lago Riesco.

Land use: Tourism in some of the National Parks.

Waterfowl: An extremely important breeding area for southern waterfowl, notably species of grebe Podicipedidae, the swans *Cygnus melancoryphus* and *Coscoroba coscoroba*, the geese *Chloephaga poliocephala, picta* and *hybrida*, many ducks including *Lophonetta specularioides, Tachyeres pteneres, T. patachonicus* and *Anas sibilatrix*, and *Fulica* spp. *Phoenicopterus chilensis* occurs as a non-breeding visitor, and large numbers of Anatidae overwinter in the sheltered fjords. Several Nearctic shorebirds occur during the austral summer, particularly *Limosa haemastica, Numenius phaeopus, Calidris bairdii* and *C. alba.*

Other fauna: There are large breeding colonies of sea-birds on many of the islands, and the sea-lion *Otaria flavescens* and fur seal *Arctocephalus australis* are common. *Lutra felina* occurs along the coasts, and *L. provocax* is known from San Rafael National Park. Amphibians include *Bufo variegatus* and *Pleurodema bufonina.*

Threats: Much of the area is very remote, seldom visited and under no threat at present. There is some marine pollution from oil tankers in the Isla Guamblin National Park; the opening up of a ship canal across the Ofqui isthmus will cause some ecological disturbance in the San Rafael National Park; and uncontrolled tourism in the O'Higgins, Torres del Paine and Monte Balmaceda National Parks is causing some damage to the ecosystems.

Research and conservation: A management plan has been produced for the Torres del Paine National Park, but otherwise very little research has been done in the area other than preliminary investigations of the fauna and flora of some of the national parks, e.g. San Rafael and Torres del Paine.

References: Markham (1970); Pisano (1971); CONAF (1975); Cardenas (1976); Universidad de Chile de Valparaiso (1978); Riveros (1979); Rau (1980); IUCN (1982); Clark *et al* (1984).

Source: Roberto Schlatter and Luis A. Espinosa.

Criteria for inclusion: 123.

Wetlands in the Hernando de Magallanes and Alberto d'Agostini National Parks and Isla Holanda Forest Reserve (45)

Location: 52°45'S, 74°45'W to 55°15'S, 68°00'W; southwest Tierra del Fuego and archipelagos south of the Straits of Magellan and Beagle Channel, Region XII.

Area: 980,000 ha of wetlands.

Altitude: 0-700m.

Province and type: 8.11.2/7.4.9; 01, 02, 03, 04, 05, 06, 07, 10, 12, 13, 14 & 19.

Site description: The fjordland of southwestern Tierra del Fuego, the Isla Santa Ines archipelago and the Isla Holanda archipelago, together stretching for 580 kms from the west end of the Straits of Magellan to near Cape Horn. Numerous islands, sea bays and fjords with rocky and sandy coasts; small estuaries with intertidal mudflats and salt marshes; fast-flowing rivers and streams; small freshwater lakes and marshes; some small inland salt lakes; extensive areas of tundra and peat bog; and low elevation glaciers and snow fields.

Principal vegetation: In a region of Magellanic forest and Magellanic tundra.

Land tenure: State owned (fiscal).

Protection: Protected within the two contiguous National Parks, Hernando de Magallanes and Alberto d'Agostini (1,600,000 ha), and the adjacent Isla Holanda Forest Reserve (300,000 ha).

Land use: Some fishing for shellfish.

Waterfowl: An important area for breeding Anatidae including the geese *Chloephaga poliocephala, C. picta* and *C. hybrida, Lophonetta specularioides, Tachyeres pteneres*, various *Anas* spp and *Merganetta armata.*
Other fauna: There are large breeding colonies of sea-birds on many of the islands, and the sea-lion *Otaria flavescens* and otter *Lutra felina* occur.
Threats: Some birds are captured for use as bait in crab fishing.
References: Humphrey *et al* (1970); Parmalee & MacDonald (1975); Sielfeld (1977).
Source: Roberto Schlatter and Luis A. Espinosa.
Criteria for inclusion: 123.

Wetlands in Cabo de Hornos National Park (46)

Location: 55°45'S, 67°30'W; at the extreme southern tip of the continent, Region XII.
Area: 38,000 ha of wetlands.
Altitude: 0-100m.
Province and type: 7.4.9; 01, 03, 04, 05, 06, 07, 10, 12 & 19.
Site description: The many small islands in the Cape Horn Archipelago with rocky and sandy coasts; sheltered bays with intertidal mudflats and salt marshes; numerous small streams, freshwater lakes and marshes; extensive peat bogs and areas of tundra; and permanent snow fields on high ground.
Principal vegetation: In a region of Magellanic tundra and humid Magellanic forest with *Nothofagus nitida* and *N. antarctica.*
Land tenure: State owned (fiscal).
Protection: Within the Cabo de Hornos National Park (63,093 ha) established in 1945.
Land use: Very remote and seldom visited.
Waterfowl: An important breeding area for many waterfowl including *Nycticorax nycticorax, Theristicus caudatus melanopis, Chloephaga poliocephala, picta* and *hybrida, Lophonetta specularioides, Tachyeres pteneres, T. patachonicus*, various *Anas* spp, and a variety of shorebirds including *Haematopus leucopodus, H. ater, Charadrius modestus* and the rare *Gallinago s. stricklandii.* Small numbers of several Nearctic shorebirds occur, notably *Tringa melanoleuca, Calidris fuscicollis* and *C. bairdii*, and the local seedsnipe *Attagis malouinus* occurs.
Other fauna: There are a number of sea-bird colonies, and *Falco peregrinus cassini* breeds. Mammals include the two otters *Lutra felina* and *L. provocax*, and *Otaria flavescens* and *Arctocephalus australis.*
Threats: None at present.
Research and conservation: Apparently none other than preliminary studies of the fauna and flora.
References: Olrog (1950); Venegas (1981); IUCN (1982).
Source: Roberto Schlatter and Luis A. Espinosa.
Criteria for inclusion: 123.

Laguna Blanca and the Seno de Otway and Segunda Angostura area (47)

Location: 52°25'S, 71°10'W; north of Punta Arenas on the Straits of Magellan, Region XII.
Area: c.500,000 ha.
Altitude: 0-100m.
Province and type: 8.26.8; 01, 02, 03, 04, 05, 06, 07, 10, 12, 13, 16 & 19.
Site description: An area of Patagonian steppe and tundra with numerous freshwater lakes, marshes and peat bogs, between the Seno de Otway (a large sea bay) and the Segunda Angostura (a branch of the Straits of Magellan). There are rocky and sandy sea shores, small offshore islands, and small estuaries with intertidal mudflats and salt marshes. Inland, the principal lakes are Laguna Blanca (17,500 ha), Laguna El Toro and Laguna Cabeza del Mar. There are numerous small fast-flowing rivers and streams, and areas of seasonally flooded grassland.

Principal vegetation: In the Patagonian steppe zone. Most of the lakes have little vegetation, although some have dense islands of *Carex* sp and *Caltha* sp.
Land tenure: Private and/or public ownership.
Protection: None.
Land use: There is some human settlement for ranching, and much of the forest has been cleared.
Waterfowl: The area supports large numbers of breeding waterfowl of a wide variety of species including *Theristicus caudatus melanopis*, *Chloephaga poliocephala*, *C. picta*, *Tachyeres patachonicus*, eight species of *Anas*, *Netta peposaca*, *Fulica armillata*, *F. leucoptera* and several species of shorebirds. Fjeldsa observed seven *Chloephaga rubidiceps* in the area in November 1981; this species is now endangered on the South American mainland. A number of Nearctic shorebirds, notably *Limosa haemastica*, *Calidris fuscicollis* and *C. bairdii*, occur in the austral summer.
Other fauna: No information.
Threats: Some of the marshes are being drained for pastureland.
Source: Roberto Schlatter, Luis A. Espinosa and Jon Fjeldsa.
Criteria for inclusion: 1a, 2a & 3a.

Wetlands in Laguna Parrillar Forest Reserve (48)

Location: 53°25'S, 71°17'W; 40 km southwest of Punta Arenas, Region XII.
Area: 7,100 ha of wetlands.
Altitude: 900m.
Province and type: 8.11.2; 10, 12 & 19.
Site description: A number of freshwater lakes and marshes, fast-flowing rivers and streams, and extensive bogs fed by snow melt in a mountainous area by the Straits of Magellan.
Principal vegetation: In a region of humid Magellanic forest.
Land tenure: State owned (fiscal).
Protection: Within the Laguna Parrillar Forest Reserve (20,814 ha) established in 1981.
Land use: No information.
Waterfowl: No information.
Other fauna: No information.
Threats: None known.
Source: Roberto Schlatter and Luis A. Espinosa.
Criteria for inclusion: 0.

Los Cisnes Natural Monument and nearby lakes (49)

Location: 53°14'S, 70°22'W; north of Porvenir, on Tierra del Fuego, Region XII.
Area: 15,000 ha of wetlands.
Altitude: 0-5m.
Province and type: 8.26.8; 12 & 14.
Site description: A complex of relatively shallow fresh, brackish and saline lakes and associated marshes near the northwest coast of Tierra del Fuego. The area includes Lago los Cisnes and Laguna Deseada.
Principal vegetation: In a region of Patagonian steppe with some low scrub.
Land tenure: The Natural Monument is state owned (Ministry of Education); the remainder is privately owned.
Protection: Lago los Cisnes is included within the Los Cisnes Natural Monument (2,358 ha); the remainder of the area is unprotected.
Land use: Cattle ranching on unprotected and surrounding land.
Waterfowl: An important breeding and wintering area for large numbers of waterfowl including *Phoenicopterus chilensis* (over 1,500 in July 1976), *Cygnus melancoryphus* (over 100 in July 1976), *Coscoroba coscoroba* (over 100 in July 1976), *Chloephaga picta*, and several species of ducks and shorebirds. The very local Magellanic Plover *Pluvianellus socialis* is fairly common in this area.

Other fauna: No information.
Threats: None known.
References: Humphrey *et al* (1970); Jory *et al* (1974).
Source: Roberto Schlatter, Luis A. Espinosa and Derek A. Scott.
Criteria for inclusion: 1a & 3a.

Bahia Inutil, Laguna Larga and surroundings (50)

Location: 53°30'S, 69°20'W; west-central Tierra del Fuego, Region XII.
Area: 429,000 ha (including terrestrial habitats).
Altitude: 0-60m.
Province and type: 8.26.8; 01, 02, 03, 05, 06, 07, 10, 12, 16 & 19.
Site description: A large sea bay (Bahia Inutil) with sandy beaches, small islands, and several small estuaries with intertidal mudflats and salt marshes; and the adjacent steppe with numerous fresh and brackish lakes and marshes, fast-flowing rivers and streams, areas of seasonally flooded grassland and bogs. The largest lake is Laguna Larga.
Principal vegetation: In a region of Patagonian steppe.
Land tenure: Public and/or private ownership.
Protection: None.
Land use: Ranching.
Waterfowl: No information.
Other fauna: No information.
Threats: No information.
References: Humphrey *et al* (1970).
Source: Roberto Schlatter and Luis A. Espinosa.
Criteria for inclusion: 0.

COLOMBIA

INTRODUCTION

by **Luis G. Naranjo**

Colombia is situated in the extreme northeast of South America. It has a surface area of 1,141,736 sq.km and a population of 25,614,000. The country borders on the Caribbean Sea and the Pacific Ocean, and in both drainages there are many rivers, lagoons, marshes, mangrove swamps, estuaries, gulfs and bays providing suitable habitat for numerous species of waterfowl.

The topography of the country is dominated by the northern extremity of the Andes which is divided into three main branches, the Ramal Occidental, Cordillera Central and Cordillera Oriental. Colombia's four main drainage basins are characterized by their climatic conditions and typical plant formations:

a) The Caribbean watershed (435,000 sq.km) includes the rivers which flow into the Caribbean Sea, the chief of which is the Rio Magdalena with its tributaries, the Cauca, Cesar, San Jorge, etc. In the lowlands of the Magdalena basin, to the east of the Gulf of Uraba, there is an extensive area of lakes and marshes which is perhaps the most important wetland system in Colombia from the point of view of waterfowl. The principal wetlands in this system are the Cienagas del Magdalena (2,890 sq.km), Cienagas del San Jorge (753 sq.km), Cienagas del Sinu (345 sq.km) and Cienagas del Cauca (247 sq.km). All the wetlands in this system are worthy of special attention, not only because they constitute important natural refuges for resident and migratory waterfowl, but also because they support one of the richest fish communities in northern South America. The basin of the Rio Atrato, in the western Caribbean lowlands, is separated from the basin of the Magdalena by the northern end of the western Andes. It is of great biogeographical interest in that its humid climate supports tropical rain forest, in contrast to the relatively arid conditions on the rest of the Caribbean coast of Colombia.

b) The Pacific watershed (90,000 sq.km) includes a large number of short rivers with abundant flow which generally enter the sea through estuarine systems with mangrove swamps. Some of the principal rivers are the San Juan, Patia, Baudo and Mira. Because of its high rainfall, this watershed includes some of the richest humid tropical forests in Colombia.

c) The Amazon watershed (332,000 sq.km) includes the basins of several large tributaries of the Amazon, notably the Putumayo, Caqueta and Vaupes. In addition to the main rivers, there is an intricate network of small rivers, channels and associated lakes. Much of the watershed is poorly known.

d) The Orinoco watershed (263,000 sq.km) includes several large tributaries of the Orinoco, notably the Arauca, Meta and Vichada. It comprises the region known as the Llanos Orientales and has large areas of seasonally flooded marshes, permanent swamps, and numerous river channels and streams.

Some geographers recognize a fifth watershed, the basin of the Rio Catatumbo (18,500 sq.km), which is usually included in the Caribbean watershed. This system flows into the Gulf of Maracaibo in Venezuela and includes the Zulia, Sardinata, Tarra and Tachira rivers.

In the highlands of Colombia, there are bogs, marshes and oxbow lakes important for resident and migratory waterfowl along the upper course of the Rio Cauca, between the Ramal Occidental and the Cordillera Central, and similarly along the upper course of the Rio Magdalena, between the Cordillera Central and the Cordillera Oriental. Finally, in the high Andes, there are many glacial lakes, paramo wetlands and mountain rivers important for a variety of waterfowl, many of which are endemic to Colombia.

Institutional Base for Wetland Conservation and Research

Until the 1960s, conservation was very much an unexplored field in Colombia, and only occasional measures had been taken. Research on renewable natural resources was conducted primarily by the universities and museums such as, for example, the Universidad Nacional de Colombia and its Instituto de Ciencias Naturales in Bogota. At present, the organizations dedicated to conservation are as follows:

Governmental

The Instituto Nacional de los Recursos Naturales Renovables y del Ambiente (INDERENA), created by the Government in 1968 within the Ministerio de Agricultura. INDERENA is responsible for controlling the exploitation of renewable natural resources and furthering research necessary for the implementation of a conservation policy in accordance with the development of the country. The Codigo Nacional de Recursos Naturales Renovables y de la Proteccion del Medio Ambiente provides the legislative instrument under which the management, exploitation and conservation of wildlife resources, land and water is considered. An extensive network of Reserves, National Parks and Faunal and Floral Sanctuaries administered by INDERENA gives some legal protection to a total of 3,958,750 ha of Colombian territory.

The Corporacion Autonoma Regional del Cauca (CVC). This administers some protected areas such as the Laguna de Sonso and Bosque de Yotoco Reserves, and Las Hermosas and Los Farallones de Cali National Parks.

The Corporacion de los Rios Sinu y San Jorge.

The Corporacion del Golfo de Uraba.

CAR, which operates in the altiplano of Cundiboyaca.

Non-governmental

The Fundacion Merenberg para la conservacion del bosque andino.

The Fundacion Herencia Verde.

The Sociedad Vallecaucana de Ornitologia.

As regards research, during the last two decades governmental organizations such as COLCIENCIAS, the Fundacion para la Educacion Superior (FES), and the Instituto Colombiano para el Fomento de la Educacion Superior (ICFES), have given considerable financial support to research work. However, most of the research has been directed from certain specialized universities and institutes. These include the following:

In Bogota: the Universidad Nacional de Colombia, the Instituto de Ciencias Naturales, the Universidad de los Andes, and the Museo del Mar.

In Cali: the Universidad del Valle and the Instituto Vallecaucano de Investigaciones Cientificas (INCIVA).

In Medellin: the Universidad de Antioquia and the Museo del Colegio San Jose.

In Cartagena: the Centro de Investigaciones Pesqueras in INDERENA and the Universidad Jorge Tadeo Lozano.

In Santa Marta: the Instituto de Investigaciones Marinas de Punta Betin.

However, the study of wetlands in Colombia has only been directed towards fishing and research related to aquaculture.

Progress in Wetland Conservation and Research

In 1974, the Colombian Government passed a law, the "Codigo Nacional de Recursos Naturales Renovables y de la Proteccion del Medio Ambiente", in which regulations were established for the use, supply and management of hydrobiological resources including both the wetlands themselves and matters relating to fishing activities, aquaculture and mariculture. A further law, passed in 1978, introduced regulations for the management, exploitation, conservation and preservation of fauna which, although not totally aquatic, is dependent during part of its life cycle on aquatic ecosystems. Under this legislation, INDERENA and the autonomous regional corporations concerned with environmental conservation are responsible for, and have the right to control, any type of human activity related to wetlands. A law passed in 1977 dealt with aspects concerning the establishment of reserves under the Codigo Nacional de Recursos Naturales.

Within the national system of parks and reserves, wetlands are represented in the following:

National Parks (Parques Nacionales Naturales)
- *El Tuparro* (548,000 ha); swamps, marshes, seasonally flooded plains, channels and rivers in the llanos.
- *El Cocuy* (306,000 ha); high Andean lakes and torrents.
- *Amacayacu* (170,000 ha); floodplains, channels and rivers in the Amazon drainage.
- *Sumapaz* (154,000 ha); high Andean lakes and torrents.
- *Los Farallones de Cali* (150,000 ha); Andean torrents.
- *Las Hermosas* (125,000 ha); high Andean lakes and torrents.
- *Sanquianga* (89,000 ha); floodplains, brackish channels and mangrove swamps.
- *Purace* (83,000 ha); high Andean lakes and torrents.
- *Los Katios* (72,000 ha); coastal waters, mangrove swamps, rivers and forest lakes.
- *Chingaza* (50,000 ha); high Andean lakes and torrents.
- *Los Nevados* (38,000 ha); high Andean lakes and torrents.
- *Isla de Salamanca* (21,000 ha); sea coasts, brackish lagoons, mangrove swamps and hypersaline pools.
- *Tayrona* (15,000 ha); small rivers, shallow bays and rocky coasts.

Faunal and Floral Sanctuaries (Santuarios de Fauna y Flora)
- *Arauca* (90,000 ha); seasonally flooded plains, rivers, channels, swamps and oxbow lakes on the llanos.
- *Cienaga Grande de Santa Marta* (23,000 ha); freshwater lakes, swamps and flooded forest.

Faunal Sanctuaries (Santuarios de Fauna)
- *Los Flamencos* (7,000 ha); brackish lagoons, shallow brackish marshes and coastal lagoons connected with the Caribbean.

Nature Reserves (Reservas Naturales)
- *Laguna de Sonso* (2,000 ha); a lake adjacent to the Rio Cauca, and adjoining oxbow lakes.

Although there are many protected areas which are important for waterfowl, only three, Isla de Salamanca, Los Flamencos and Laguna de Sonso, were created especially for the conservation of their avifauna. The funds allocated by the Government for maintaining and wardening the National Parks, Reserves and Sanctuaries are small, and therefore the accomplishments in terms of conservation are more theoretical than practical. The policy of expansion in agriculture and ranching in Colombia in the last two decades has affected some areas formerly of importance for waterfowl. In general, priorities for land-use conflict with the Codigo Nacional de Recursos Naturales Renovables y de la Proteccion del Medio Ambiente. This law establishes that a major obligation in any development is to conduct environmental impact studies to determine to what extent a land-use project is harmful or beneficial.

Since the beginning of the last decade, a considerable amount of research has been conducted on the limnology and fisheries potential of various important wetlands. The INDERENA/FAO programme for the development of the continental fishery in Colombia, the Universidad Jorge Tadeo Lozano in Bogota and Cartagena, and the Instituto de Investigaciones Marinas de Punta de Betin have accumulated a large number of unpublished reports which would be useful in the development of a strategy for the management and conservation of wetlands.

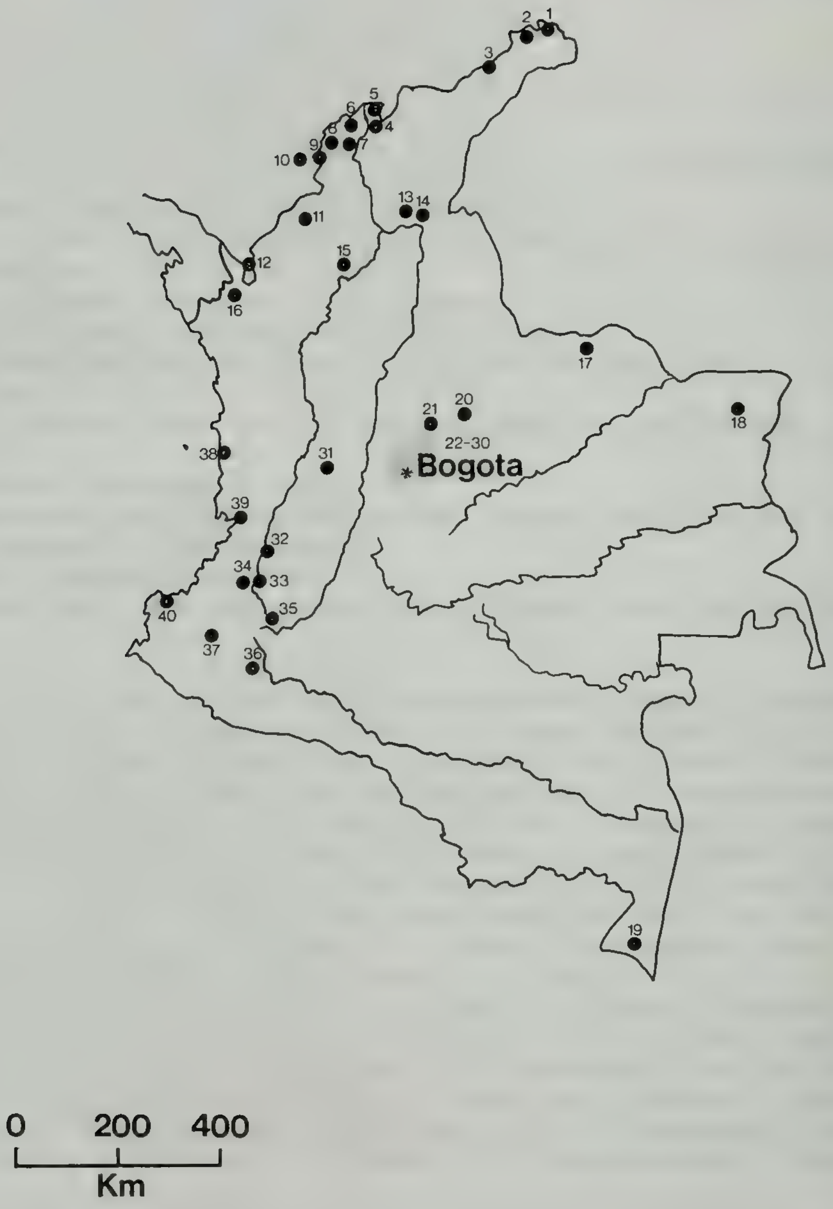
Research on waterfowl, however, has long been neglected in Colombia, and only in recent years have any serious projects been undertaken. These include studies of the following:

a) The feeding ecology of shorebirds (Charadriidae and Scolopacidae) in the Bay of Buenaventura (J. W. Beltran, Universidad del Valle).
b) Waterfowl use of the Cienaga Grande de Santa Marta (J. E. Botero, University of Wisconsin).

c) The chronological distribution and habitat utilization of shorebirds (Charadriidae and Scolopacidae) in the Bay of Buenaventura (R. Franke, Universidad del Valle).
d) The taxonomy, zoogeography and ecology of the sea-birds of the Caribbean coast of Colombia (L. G. Naranjo, Universidad Jorge Tadeo Lozano).
e) The natural history of the Horned Screamer *Anhima cornuta* (L. G. Naranjo, Universidad del Valle).
f) The ecology and behaviour of the Wattled Jacana *Jacana jacana* in the Cauca Valley (R. Velosa, Universidad del Valle).

In addition, a number of articles and publications have appeared concerning particular species of waterfowl or the bird communities at particular wetlands.

COLOMBIA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WETLANDS

Site descriptions based on data sheets provided by Luis German Naranjo and Jorge E. Botero, with contributions from German I. Andrade, Juan G. Arango, Elisabeth Buttkus, Jon Fjeldsa, Carolina Murcia and Marco A. Serna.

Bahia Hondita (1)

Location: 12°25'N, 71°43'W; 100 km NNE of Uribia, Guajira Department.
Area: 4,000 ha.
Altitude: 0m.
Province and type: 8.17.4; 01.
Site description: A shallow inlet, up to 2m deep, of Bahia Honda, with little tidal variation.
Principal vegetation: In a region of semi-arid scrub (matorral).
Land tenure: A mixture of state and private ownership.
Protection: No habitat protection, but INDERENA is responsible for controlling hunting and fishing.
Land use: Exploitation of salt, and fishing.
Waterfowl: An important area for *Phoenicopterus ruber*; several hundred occur each year, and the species is reported to have nested.
Other fauna: No information.
Threats: There is a considerable amount of disturbance from human activities in the area.
References: Serna (1984).
Source: Luis German Naranjo.
Criteria for inclusion: 1b.

Bahia Portete (2)

Location: 12°13'N, 71°55'W; 60 km NNE of Uribia, Guajira Department.
Area: 15,000 ha.
Altitude: 0m.
Province and type: 8.17.4; 01, 05, 06 & 08.
Site description: A shallow sea bay with little tidal fluctuation, almost closed off from the open sea by a sand barrier. The salinity is high (40 p.p.t.), and there are some tidal mudflats and small patches of mangroves. The bay is the most important mangrove/mudflat system on the Guajira Peninsula.
Principal vegetation: Mangroves dominated by *Rhizophora mangle*, with some *Avicennia germinans*. In a region of semi-arid scrub (matorral).
Land tenure: A mixture of state and private ownership.
Protection: Supposedly protected by INDERENA.
Land use: Exploitation of salt, and coal mining. Docks are currently being built to facilitate the transportation of the coal.
Waterfowl: A wide variety of waterfowl has been recorded including *Pelecanus occidentalis*, *Egretta rufescens*, *Euxenura maguari*, *Eudocimus ruber* (common), *E. albus* (scarce), *Ajaia ajaja*, *Himantopus himantopus* and many Nearctic shorebirds. The area is particularly important for *Phoenicopterus ruber* which occurs regularly as a non-breeding visitor, and may have nested.
Other fauna: *Conirostrum bicolor* and *Dendroica petechia* occur in the mangroves, and *Pandion haliaetus* is a regular winter visitor.
Threats: Disturbance from shipping, particularly in the transportation of coal, and some associated contamination of shallow water areas.
Research and conservation: Serna has documented the avifauna of the area, and environmental impact studies have recently been carried out in relation to the construction of docks for the coal industry, but the results of these have not as yet been published.

References: Serna (1984).
Source: Luis German Naranjo.
Criteria for inclusion: 1b & 3a.

Salinas de San Juan and Cienaga de San Agustin (3)

Location: 11°45'N, 72°30'W; 50 km ENE of Riohacha, Guajira Department.
Area: c.11,000 ha.
Altitude: 0-5m.
Province and type: 8.17.4; 05, 06, 07 & 08.
Site description: A coastal zone stretching for some 20 km, with a narrow strip of intertidal sand and mud-flats, a low sandy beach ridge, and a chain of shallow saline lagoons with mangrove swamps. Approximately 4,000 ha of low-lying salt flats periodically inundated by high tides were converted into salt pans for salt extraction in the early 1970s.
Principal vegetation: Mangrove swamps with *Avicennia germinans, Laguncularia racemosa* and *Rhizophora mangle*; saline marshes with *Sporobolus virginianus* and *Batis maritima*; and offshore beds of *Thalassia* sp and *Diplanthera* sp. In a region of semi-arid woodland with *Prosopis* sp, *Acacia* sp and various Cactaceae.
Land tenure: A mixture of state and private ownership; all but 100 ha of the Nature Sanctuary is state owned.
Protection: 7,000 ha of coastal lagoons and marshes are included within Los Flamencos Faunal Sanctuary, established in 1977.
Land use: Exploitation of salt and fishing. There is some traditional fishing in the Nature Sanctuary, but otherwise the area is very little disturbed.
Waterfowl: *Phoenicopterus ruber* occurs throughout the year as a non-breeding visitor, andup to 1,300 have been recorded. In June 1974, Sprunt observed large numbers of *Pelecanus occidentalis, Phalacrocorax olivaceus, Egretta tricolor, E. thula, Eudocimus albus*, shorebirds and Laridae, along with 100 *Egretta rufescens* (probably breeding in the mangroves), 100 *Mycteria americana* and 200-250 *Ajaia ajaja.*
Other fauna: No information.
Threats: None known.
Research and conservation: Very little research seems to have been conducted in this important area.
References: Sprunt (1976); IUCN (1982); Serna (1984).
Source: See references.
Criteria for inclusion: 1b & 3a.

Cienaga Grande de Santa Marta (4)

Location: 10°44'-11°00'N, 74°15'-74°31'W; east of Barranquilla, Magdalena Department.
Area: 50,000 ha.
Altitude: 0-20m.
Province and type: 8.17.4; 02, 07, 08, 09, 12 & 18.
Site description: A complex of wetland habitats near the mouth of the Rio Magdalena, including large shallow brackish to saline lagoons and mangrove swamps near the coast, and extensive freshwater lakes, marshes and swamp forest flooded by the Rio Magdalena further inland. The lagoons are up to 3m deep, but water levels fluctuate seasonally by up to 60 cm, and during the dry season, large portions of the marshes dry out. Salinities range from as high as 45 p.p.t. near the coast to fresh in the south.
Principal vegetation: Mangrove swamps with *Avicennia germinans, Laguncularia racemosa* and *Rhizophora mangle*; fresh to brackish marshes with *Nymphaea* sp, *Eichhornia*sp, *Typha* sp and various Cyperaceae; and swamp forest with *Erythrina fusca.* In a region of semi-arid tropical woodland.
Land tenure: A mixture of state and private ownership. 95% of the Sanctuary is state owned.

Protection: 23,000 ha of the wetland are included within a National Park and Sanctuary, the "Parque Nacional Natural y Santuario Faunistico Cienaga Grande de Santa Marta", established in 1977. Elsewhere, there are restrictions on hunting, fishing and the exploitation of timber.
Land use: Intensive traditional fishing, particularly for oysters and shrimps; sport and subsistence hunting; exploitation of mangroves for timber; navigation; and recreation. Agriculture and cattle ranching in surrounding areas.
Waterfowl: The most important wetland area for waterfowl on the Caribbean coast of Colombia, with large concentrations of both resident breeding species and Nearctic migrants. There are important breeding populations of *Phalacrocorax olivaceus*, a variety of Ardeidae and Threskiornithidae, *Chauna chavaria* and Anatidae (*Dendrocygna bicolor, D. autumnalis, D. viduata, Anas bahamensis, Cairina moschata* and probably *Oxyura dominica*). *Phoenicopterus ruber* is a regular non-breeding visitor in groups of up to several hundred. The area is particularly important for its large concentrations of wintering Anatidae. Up to 25,000 ducks have been observed at one time; the peak counts of the commonest species have been *20,000 Anas discors, 4,000 A. americana, 2,000 A. clypeata* and 1,000 *Aythya affinis*. The rare *Netta erythrophthalma erythrophthalma* has been recorded on several occasions in recent years, and *Sarkidiornis melanotos* has occurred. Many Nearctic shorebirds and Laridae occur as non-breeding visitors, but no census data are available.
Other fauna: The Osprey *Pandion haliaetus* is a regular non-breeding visitor. There is a very diverse fish fauna, and there are significant populations of *Caiman crocodilus fuscus, Crocodylus acutus* and the manatee *Trichechus manatus*.
Threats: Drainage in surrounding areas, canalization of river channels, blocking off of springs, water pollution, and increased sedimentation as a result of watershed degradation, have all had detrimental effects on the morphology and hydrology of the system, and pose a serious threat to the entire region. The breeding colonies of Ardeidae and Threskiornithidae have been heavily persecuted by people collecting eggs and young birds, and there was no breeding from 1978 to 1980.
Research and conservation: Several studies have been made on the fauna and flora of the Cienaga, notably by Botero in 1979 and 1980; and there have been numerous projects by INVEMAR and INDERENA on the fisheries and aquaculture.
References: Naranjo (1979b); Botero (1982 & 1983); IUCN (1982).
Source: Jorge E. Botero and Luis German Naranjo.
Criteria for inclusion: 123.

Isla de Salamanca National Park (5)

Location: 10°57'-11°06'N, 74°22'-74°58'W; east of Barranquilla, Magdalena Department.
Area: 21,000 ha.
Altitude: 0-8m.
Province and type: 8.17.4; 05, 06, 07 & 08.
Site description: Isla de Salamanca is a long narrow coastal barrier island separating the Cienaga Grande de Santa Marta from the sea, and with the mouth of the Rio Magdalena to the west. There are long sandy beaches and sand dunes, and a series of shallow brackish lagoons and mangrove swamps connected to the sea by channels at high tide. Water levels in the lagoons fall during the dry season.
Principal vegetation: Mangrove swamps with *Avicennia germinans, Laguncularia racemosa, Conocarpus erectus* and *Rhizophora mangle*; saline marshes with *Sesuvium portulacastrum* and *Batis maritima*; brackish marshes with *Typha domingensis*; and some *Erythrina fusca*. In a region of semi-arid tropical woodland with *Acacia farnesiana, Prosopis juliflora* and *Libidivia coriaria*.
Land tenure: A mixture of state and private ownership.
Protection: The island constitutes the "Parque Nacional Natural Isla de Salamanca", established in 1977. Wardening and management are however reported to be inadequate.
Land use: Traditional fishing, recreation, and navigation in the surrounding waters.
Waterfowl: Similar to that of the Cienaga Grande de Santa Marta, with large numbers of breeding and wintering Ardeidae, Threskiornithidae, Anatidae, shorebirds and Laridae.

Other fauna: Over 170 species of birds have been recorded on the island. There is a great diversity of fishes, amphibians and reptiles, and the manatee *Trichechus manatus* occurs.
Threats: The construction of a road along the island has caused changes in salinity in some of the lagoons and this has resulted in the death of large areas of mangroves. Automobile traffic causes constant disturbance, and high tension power lines through the park cause considerable bird mortality. Pollution from domestic sewage and industrial waste is a serious problem in the Rio Magdalena. The illegal hunting of sea turtles and iguanas, and the collection of birds' eggs and chicks for human consumption also cause problems.
Research and conservation: Several faunal and floral surveys have been conducted in the park, and the avifauna is particularly well known. Unfortunately, enforcement of the Park regulations is very poor.
References: Toro *et al* (1975); Franky & Rodriguez (1977); Naranjo (1979a, 1979b & 1981); IUCN (1982).
Source: Luis German Naranjo.
Criteria for inclusion: 123.

Cienaga del Totumo (6)

Location: 10°45'N, 75°14'W; 45 km northeast of Cartagena, Atlantico Department.
Area: 2,100 ha.
Altitude: 0m.
Province and type: 8.17.4; 07.
Site description: A shallow brackish coastal lagoon, up to 1.2m deep, connecting with the sea through a channel, the Cano Amansaguapos. A dam and sluice have been constructed across the channel and water flow is controlled. The salinity of the lagoon has decreased since the construction of the dam, and the water is now almost fresh.
Principal vegetation: In a region of dry tropical woodland with *Crescentia cujete, Acacia farnesiana, Libidivia coriaria, Prosopis juliflora, Bombacopsis quinata* and *Lecythis minor.*
Land tenure: A mixture of state and private ownership.
Protection: None.
Land use: Traditional fishing, extraction of salt, and occasional hunting; cattle ranching and agriculture in surrounding areas.
Waterfowl: An important lagoon for both resident and migrant species, particularly fish-eating birds and Laridae. Residents include *Pelecanus occidentalis, Phalacrocorax olivaceus, Anhinga anhinga, Egretta caerulea, E. tricolor, Dendrocygna autumnalis, Charadrius wilsonius* and *C. collaris.* Nearctic migrants include *Butorides virescens, Ardea herodias, Anas discors,* twelve species of shorebirds and several gulls and terns Laridae.
Other fauna: The area is rich in birds of prey and Psittacidae. Reptiles include *Caiman crocodilus, Crocodylus acutus, Chrysemys scripta, Iguana iguana* and *Pseudoboa newiedii.*
Threats: The decreasing salinity of the lagoon is presumably affecting fish populations, and pollution from pesticide run-off is likely to cause problems in the future.
Research and conservation: A preliminary limnological investigation was made by Mercado; and avifaunal studies were conducted by Naranjo between 1977 and 1979. The lagoon merits protection as an important wintering area for migratory waterfowl.
References: Mercado (1971).
Source: Luis German Naranjo.
Criteria for inclusion: 2b & 3a.

Cienaga de Guajaro (7)

Location: 10°30'N, 75°08'W; 45 km east of Cartagena, Atlantico Department.
Area: 15,000 ha.
Altitude: 9m.
Province and type: 8.17.4; 15, 16 & 17.

Site description: A complex of thirteen shallow interconnecting freshwater lakes and associated marshes behind the dam of the Canal del Dique; with adjacent seasonally inundated grassland and rice-growing areas. The principal lakes are Guajaro, Bonanza, Cabildo, Celosa, Playon del Hacha and Puerco. Water levels fluctuate according to the level in the Rio Magdalena, and reach a maximum of 4.5m.
Principal vegetation: Lakes and marshes with *Eichhornia crassipes* and species of *Eleocharis, Pistia* and *Typha*; gallery forest with *Cecropia* and *Aeschynomene* spp; and dry tropical woodland with *Prosopis juliflora.*
Land tenure: A mixture of state and private ownership.
Protection: No habitat protection; INDERENA controls the fishing and hunting.
Land use: Traditional fishing, subsistence hunting, occasional sport hunting, and navigation; with rice-growing, other agriculture and cattle ranching in surrounding areas.
Waterfowl: An important area for species typical of the cienagas of northern Colombia, notably species of Podicipedidae, Ardeidae, Ciconiidae, Threskiornithidae, Anatidae and Rallidae (see Cienaga de Zapatosa (14)).
Other fauna: The manatee *Trichechus manatus* has been recorded.
Threats: Pollution in the Rio Magdalena and Canal del Dique, and pesticide run-off from adjacent agricultural land are the main threats.
Research and conservation: INDERENA and FAO have carried out several limnological and fisheries investigations in the area.
References: Ducharme (1975).
Source: Luis German Naranjo.
Criteria for inclusion: 3a.

Cienaga de la Virgen (8)

Location: 10°27'N, 75°30'W; north of Cartagena, Bolivar Department.
Area: 2,250 ha.
Altitude: 0m.
Province and type: 8.17.4; 07 & 08.
Site description: A shallow brackish coastal lagoon, averaging 1.5m deep, with some mangrove swamps; in communication with the sea through several channels, and fed by freshwater streams.
Principal vegetation: Mangrove swamps with *Avicennia germinans, Laguncularia racemosa, Conocarpus erectus, Pelliciera rhizophorae* and *Rhizophora mangle*; dry tropical woodland in surrounding areas with *Prosopis juliflora, Acacia farnesiana* and *Libidivia coriaria.*
Land tenure: A mixture of state and private ownership.
Protection: No habitat protection, but there are regulations concerning fishing and some pollution control.
Land use: Commercial and traditional fishing. The city of Cartagena almost surrounds the lagoon, and there are various industries sited on its shores; elsewhere there is some cattle ranching, agriculture and tourist recreation.
Waterfowl: An important lagoon for breeding, passage and wintering species. Residents include *Pelecanus occidentalis, Phalacrocorax olivaceus, Anhinga anhinga, Nyctanassa violacea, Egretta caerulea, E. tricolor, E. rufescens, Eudocimus albus, Dendrocygna autumnalis* and *Himantopus himantopus*; South American migrants include *Charadrius collaris, Phaetusa simplex* and *Rynchops niger*; and Nearctic migrants include *Anas discors*, nineteen species of shorebirds, and eight species of Laridae.
Other fauna: No information.
Threats: The main threat is pollution from Cartagena city, including thermal pollution and contamination with hydrocarbons, heavy metals and domestic sewage. Mangroves are being cut down and parts of the wetland are being filled in. Tourist recreation and hunting cause excessive disturbance.
Research and conservation: The Marine Museum and Faculty of Marine Biology at the Jorge Tadeo Lozano University in Bogota have accumulated a great deal of information on various aspects of the lagoon including the pollution problem, and much of this has been written up in several University dissertations. The bird fauna of the lake has been well documented by Naranjo.

References: Mercado (1968); Naranjo (1979b).
Source: Luis German Naranjo.
Criteria for inclusion: 2b & 3a.

Bahia de Cartagena (9)

Location: 10°20'N, 75°33'W; south of Cartagena, Bolivar Department.
Area: 12,000 ha.
Altitude: 0m.
Province and type: 8.17.4; 01, 02, 03, 05, 06, 07 & 08.
Site description: A large sea bay with several small islands, and the mouth of the Canal del Dique; wetland habitats include shallow inshore waters, intertidal mudflats, sandy beaches, brackish to saline coastal lagoons, and mangroves swamps. Tidal variation in the bay is less than one metre.
Principal vegetation: Mangrove swamps with *Avicennia germinans, Laguncularia racemosa* and *Rhizophora mangle*; woodland with *Bombacopsis quinata, Lecythis minor* and *Astronium graveolens.*
Land tenure: A mixture of state and private ownership.
Protection: None.
Land use: The city of Cartagena, the Mamonal Industrial Estate and various oil installations border on parts of the bay; and there is tourist recreation and traditional fishing elsewhere.
Waterfowl: Important for breeding, passage and wintering waterfowl. Residents include *Pelecanus occidentalis, Phalacrocorax olivaceus, Nyctanassa violacea, Egretta caerulea, E. tricolor, E. rufescens, Charadrius wilsonius* and *Himantopus himantopus.* Nearctic migrants include *Ardea herodias*, seventeen species of shorebirds, *Larus atricilla* and seven species of terns *Chlidonias, Hydroprogne* and *Sterna.*
Other fauna: No information.
Threats: The principal threat is pollution including thermal pollution and contamination with chemicals, heavy metals, domestic sewage and rubbish. Tourist recreation causes excessive disturbance.
Research and conservation: The Marine Museum and Faculty of Marine Biology at the Jorge Tadeo Lozano University in Bogota have conducted oceanographic and biological studies in the bay.
References: Naranjo (1979b).
Source: Luis G. Naranjo and Elisabeth Buttkus.
Criteria for inclusion: 3a.

Corales del Rosario National Park (10)

Location: 10°10'N, 75°45'W; off the Caribbean coast of Cartagena Municipality, Bolivar Department.
Area: 18,700 ha (mainly marine).
Altitude: 0m.
Province and type: 8.17.4; 01, 03 & 08.
Site description: A marine park including part of Isla de Baru and the waters around the Archipelago del Rosario. The only terrestrial part of the Park is along the western edge of Isla de Baru, where there are mangrove swamps. The Park contains the most important coral platform area in Colombian waters.
Principal vegetation: Mangrove swamps with *Avicennia germinans* and *Laguncularia racemosa.*
Land tenure: State owned.
Protection: Constitutes the Corales del Rosario National Park (18,700 ha) established in 1977.
Land use: Tourism, water sports and sport fishing.
Waterfowl: An important breeding area for *Pelecanus occidentalis* (one of only four breeding sites on the Caribbean coast of Colombia), and *Fregata magnificens.*
Other fauna: Very rich coral reefs, with 60 species of coral and a diverse associated fauna.

Threats: Disturbance from tourist recreation, particularly the use of power boats, and illegal fishing. Some of the islands are being developed for tourism.
Research and conservation: A considerable amount of research in marine biology has been conducted in the Park.
References: IUCN (1982).
Source: See references.
Criteria for inclusion: 2b & 3a.

Cienaga de Lorica (11)

Location: 9°10'N, 75°43'W; east of Lorica, Cordoba Department.
Area: 11,800 ha.
Altitude: 23m.
Province and type: 8.17.4; 12 & 16.
Site description: A complex of permanent freshwater lakes and marshes, and seasonally inundated plains along the Rio Sinu. The level in the Rio Sinu fluctuates seasonally by 4.5m.
Principal vegetation: Lakes and marshes with *Eichhornia crassipes* and species of *Eleocharis, Pistia* and *Typha*; gallery forest with *Cecropia* and *Aeschynomene* spp; and dry tropical woodland with *Prosopis juliflora.*
Land tenure: A mixture of state and private ownership.
Protection: No habitat protection; the Corporacion Autonoma Regional de los Rios Sinu y San Jorge controls fishing, and hunting is prohibited.
Land use: Traditional fishing, navigation, and illegal sport and subsistence hunting. Cattle ranching and agriculture in surrounding areas.
Waterfowl: The most important wetland system in the Rio Sinu watershed, with large populations of waterfowl typical of the cienagas of northern Colombia (see Cienaga de Zapatosa (14)). The very local *Laterallus albigularis cerdaleus* occurs.
Other fauna: No information.
Threats: There is some pollution from pesticide run-off, and a considerable amount of illegal hunting.
References: Ducharme (1975).
Source: Luis German Naranjo.
Criteria for inclusion: 2b & 3a.

Golfo de Uraba (12)

Location: 7°55'-8°40'N, 76°44'-77°20'W; between Acandi and Turbo, Departments of Antioquia and Choco.
Area: c.200,000 ha.
Altitude: 0m.
Province and type: 8.3.1; 01, 02, 06, 07 & 08.
Site description: A large sea bay on the Caribbean coast fed by several important rivers with extensive estuarine marshes, intertidal mudflats and mangrove swamps.
Principal vegetation: Extensive mangrove swamps. In a region of humid tropical forest.
Land tenure: A mixture of state and private ownership.
Protection: No habitat protection. INDERENA and the Corporacion Autonoma de Uraba are responsible for protecting the fauna and flora of the region.
Land use: Traditional fishing and navigation. Exploitation of timber, cattle ranching and agriculture in surrounding areas.
Waterfowl: A very important area for a wide variety of waterfowl, including several species which are rare elsewhere in Colombia. The area is particularly rich in Nearctic migrants, with large numbers of wintering Ardeidae, Anatidae, shorebirds and Laridae. No census data are however available.
Other fauna: No information.

Threats: Urban expansion and increasing settlement along the rivers, pollution from domestic sewage, and forest clearance.
Source: Luis German Naranjo.
Criteria for inclusion: 2b & 3a.

Cienaga de Chilloa (13)

Location: 9°10'N, 74°04'W; 15 km northwest of El Banco, Magdalena Department.
Area: 20,000 ha.
Altitude: 25m.
Province and type: 8.17.4; 12, 16 & 17.
Site description: A large permanent freshwater lake and marshes fed by the Rio Magdalena, with surrounding areas of seasonally inundated grassland and arable land. The water level fluctuates with that of the Rio Magdalena, which varies in depth from 4 to 7.3m.
Principal vegetation: Lake and marshes with *Eichhornia crassipes, Pistia stratiotes* and species of *Eleocharis* and *Typha*. In a region of dry tropical woodland.
Land tenure: A mixture of state and private ownership.
Protection: No habitat protection. INDERENA controls hunting and fishing activities.
Land use: Traditional fishing, sport and subsistence hunting, and navigation; cattle ranching and agriculture in surrounding areas.
Waterfowl: An important area for waterfowl, with a species composition similar to that of the nearby Cienaga de Zapatosa (14).
Other fauna: No information.
Threats: Pollution in the Rio Magdalena, pesticide run-off from adjacent agricultural land, and inadequate control of hunting.
Research and conservation: The lake does not appear to have been studied in any detail.
Source: Luis German Naranjo.
Criteria for inclusion: 3a.

Cienaga de Zapatosa and nearby lakes (14)

Location: 9°05'N, 73°50'W; between El Banco, Chimichagua and Tamalameque, Magdalena Department.
Area: 34,000 ha.
Altitude: 30m.
Province and type: 8.17.4; 12, 16 & 17.
Site description: A vast complex of freshwater lakes and marshes along the Rio Cesar near its confluence with the Rio Magdalena; and adjacent areas of seasonally inundated grassy plains and agricultural land.
Principal vegetation: Lakes and marshes with *Eichhornia crassipes* and species of *Eleocharis, Pistia* and *Typha*; gallery forest with *Cecropia* and *Aeschynomene*;and dry tropical woodland with *Prosopis juliflora* etc.
Land tenure: A mixture of state and private ownership.
Protection: No habitat protection. INDERENA controls the fishing and is responsible for prohibiting hunting.
Land use: Traditional fishing, illegal sport and subsistence hunting, and navigation; cattle ranching and agriculture in surrounding areas.
Waterfowl: The Zapatosa complex is the principal wetland area in the lacustrine system of the middle Rio Magdalena, and supports important populations of many resident and migratory waterfowl. *Phalacrocorax olivaceus, Bubulcus ibis, Egretta thula, E. alba* and *Ardea cocoi* are particularly abundant. Other resident breeding species include *Podiceps dominicus, Anhinga anhinga, Botaurus pinnatus, Ixobrychus involucris, Tigrisoma* spp, *Pilherodius pileatus, Egretta*

caerulea, Mycteria americana, Jabiru mycteria, Theristicus caudatus, Phimosus infuscatus, Eudocimus albus, Ajaia ajaja, Chauna chavaria, all three *Dendrocygna* species, *Sarkidiornis melanotos, Cairina moschata, Oxyura dominica, Aramus guarauna*, seven species of Rallidae, *Jacana jacana, Himantopus himantopus, Phaetusa simplex* and *Rynchops niger. Vanellus chilensis* and *Burhinus bistriatus* are common on the surrounding plains. Common Nearctic migrants include *Ardea herodias, Anas discors, A. cyanoptera, Tringa solitaria, T. melanoleuca, T. flavipes, Actitis macularia, Larus atricilla*, and *Chlidonias nigra.*
Other fauna: Birds of prey are common, and include *Cathartes burrovianus, Pandion haliaetus* and *Rostrhamus sociabilis. Odocoileus virginianus* and *Alouatta seniculus* occur in the surrounding woodland.
Threats: Pollution in the Rio Magdalena and its tributaries affects the area, and there is some run-off of pesticides from adjacent agricultural land. Forest clearance continues, and hunting is uncontrolled.
Research and conservation: Together with the cienagas of the lower Rio Magdalena and the lacustrine systems of the Sinu and San Jorge rivers, the Zapatosa complex constitutes the most important wetland area in northern Colombia. However, the area remains unprotected and very poorly known.
References: Ducharme (1975).
Source: Luis German Naranjo.
Criteria for inclusion: 123.

Cienaga de Ayapel (15)

Location: 8°19'N, 75°05'W; east of Ayapel, Cordoba Department.
Area: 12,800 ha.
Altitude: 55m.
Province and type: 8.17.4; 12.
Site description: A permanent freshwater lake and marshes by the Rio San Jorge.
Principal vegetation: Similar to that of Cienaga de Zapatosa (14).
Land tenure: Largely privately owned, with some state owned.
Protection: No habitat protection. The Corporacion Autonoma de los Valles del Sinu y San Jorge is responsible for controlling the fishing and prohibiting hunting.
Land use: Traditional fishing, illegal sport and susbsistence hunting, navigation and recreation; cattle ranching and agriculture in surrounding areas.
Waterfowl: No avifaunal surveys have been conducted, but according to local reports, an important area for waterfowl, comparable to the other main cienagas in the region (e.g. Cienaga de Zapatosa).
Other fauna: No information.
Threats: Fish populations have declined as a result of overfishing, and hunting is totally uncontrolled.
Research and conservation: INDERENA has conducted some limnological investigations.
References: Ducharme (1975).
Source: Jorge E. Botero and Luis German Naranjo.
Criteria for inclusion: 0.

The lower Rio Atrato and Los Katios National Park (16)

Location: 6°50'-8°05'N, 76°45'-77°13'W; the lower Rio Atrato basin from the region of Opogodo to near its mouth on the Golfo de Uraba, Departments of Choco and Antioquia.
Area: c.670,000 ha.
Altitude: 0-150m.
Province and type: 8.3.1; 09, 11, 12 & 18.
Site description: A vast complex of freshwater lakes and marshes with surrounding swamp forest and seasonally flooded forest along the lower course of the Rio Atrato. The Cienaga de

Tumarado is one of the principal lakes in the area. Flooding occurs during the rainy season from April to November.

Principal vegetation: Lakes with extensive areas of *Eichhornia azurea, Pistia stratiotes* and *Linocharis flava*; marshes with *Montrichardia arborescens* and *Polygonum acuminatum*; and swamp forest with species of *Raphia, Erythrina, Pachira, Prioria, Ficus* and *Heliconia.* In a region of very humid tropical forest.

Land tenure: The small part within Los Katios National Park is state owned. The ownership of the remainder is unknown.

Protection: Approximately 27,000 ha of wetlands including Cienaga de Tumarado are within Los Katios National Park (72,000 ha), established in 1973. The remainder is unprotected.

Land use: Traditional fishing and exploitation of timber; some cattle ranching and agriculture in surrounding areas.

Waterfowl: Fifty-seven species of waterfowl have been listed for Los Katios National Park by Rodriguez, including several which are rare elsewhere in Colombia such as *Amaurolimnas concolor, Heliornis fulica* and *Eurypyga helias.* Other noteworthy species include *Pilherodius pileatus, Cochlearius cochlearius, Agamia agami, Mesembrinibis cayennensis, Ajaia ajaja, Chauna chavaria, Cairina moschata* and eleven species of Nearctic shorebirds. The area as a whole is undoubtedly of very great importance for waterfowl, particularly as much remains remote and relatively undisturbed.

Other fauna: About 400 bird species have been recorded in the National Park, including a variety of birds of prey dependent on wetlands, and all five South American kingfishers Alcedinidae. *Caiman crocodilus*, an otter *Lutra* sp, and Baird's Tapir *Tapirus bairdii* occur in the Park, and presumably elsewhere in the region.

Threats: No information.

Research and conservation: A variety of faunal and floral investigations have been conducted in the National Park, and the birds have been well documented by Rodriguez, but little seems to be known about the large tracts of wetland outside the Park.

References: IUCN (1982); Rodriguez (1982).

Source: Luis German Naranjo.

Criteria for inclusion: 123.

Wetlands in Arauca Faunal and Floral Sanctuary (17)

Location: 6°36'-6°53'N, 71°05'-71°25'W; in the eastern llanos of Colombia, Arauca Intendencia.

Area: Area of wetlands unknown (Sanctuary 90,000 ha).

Altitude: 150m.

Province and type: 8.27.10; 09, 11, 16 & 17.

Site description: A large area of seasonally inundated grassland, savanna and agricultural land along the Rio Arauca and its tributaries. The plains dry out during the dry season, but there are some permanent marshes along the main water courses.

Principal vegetation: Swamps with groves of *Mauritia flexuosa*; gallery forest and riverine thickets with *Ficus insipida, Bombacopsis quinatum, Ceiba pentandra, Tabebuia* sp and clumps of the bamboo *Guadua angustifolia.*

Land tenure: 70% state owned and 30% privately owned.

Protection: Within the Santuario de Fauna y Flora Arauca (90,000 ha) established in 1977.

Land use: Subsistence hunting and fishing, some illegal sport hunting, cattle ranching and agriculture.

Waterfowl: An important area for waterfowl typical of the llanos of eastern Colombia and the Orinoco basin of Venezuela. The families Ardeidae, Ciconiidae, Threskiornithidae, Anhimidae, Anatidae and Rallidae are well represented, and specialities include *Euxenura maguari, Eudocimus ruber, Neochen jubata* and *Amazonetta brasiliensis.*

Other fauna: Mammals include *Hydrochoerus hydrochaeris, Lutra enudris, Pteronura brasiliensis, Tapirus terrestris* and *Odocoileus virginianus*; and reptiles include *Caiman crocodilus* and *Crocodylus intermedius.*

Threats: Continuing colonization and an associated increase in agriculture and illegal hunting. It is reported that wardening and management of the Sanctuary are inadequate.

References: IUCN (1982).
Source: Luis German Naranjo.
Criteria for inclusion: 2a & 3a.

Wetlands in El Tuparro National Park (18)

Location: 5°00'-5°34'N, 67°52'-69°10'W; in the eastern llanos between Rio Tomo and Rio Tuparro, Vichada Comisario.
Area: c.470,000 ha.
Altitude: 125m.
Province and type: 8.27.10; 09, 11, 16 & 18.
Site description: A vast alluvial plain between the Tomo and Tuparro rivers, bounded in the east by the Orinoco River, along the Venezuelan border. Wetland habitats include slow-flowing rivers with associated riverine marshes and riverine forest, and large tracts of seasonally flooded grassland and palm savanna. 85% of the National Park is subject to seasonal flooding.
Principal vegetation: Seasonally flooded grassland with species of *Paspalum, Stipa* and *Andropogon*, and groves of the palm *Mauritia flexuosa.*
Land tenure: Almost entirely state owned, with some small private holdings.
Protection: Within the El Tuparro National Park (548,000 ha), established as a "Territorio Faunistico" in 1970, and upgraded to a "Parque Nacional Natural" in 1980.
Land use: Almost none.
Waterfowl: No information.
Other fauna: Reptiles include *Caiman crocodilus, Crocodylus intermedius, Eunectes murinus*and a variety of freshwater turtles; mammals include *Hydrochoerus hydrochaeris* and *Pteronura brasiliensis.*
Threats: None known.
Research and conservation: Some faunal and floral investigations have been conducted in the Park.
References: IUCN (1982).
Source: See references.
Criteria for inclusion: 2a & 3a.

Wetlands in Amacayacu National Park (19)

Location: 3°02'-3°47'S, 69°59'-70°25'W; in extreme southeastern Colombia, northwest of Leticia, Amazonas Department.
Area: Area of wetlands unknown (Park 170,000 ha).
Altitude: 100m.
Province and type: 8.5.1; 09, 11 & 18.
Site description: Alluvial plains along the Amazon, Amacayacu and Cotuhe rivers, on the Peruvian border. Wetland habitats include slow-flowing rivers and associated oxbow lakes and marshes, forest streams, swamp forest and seasonally flooded forest.
Principal vegetation: Oxbow lakes and marshes with *Pseudobombax munguba* and floating beds of *Victoria amazonica, Eichhornia* sp and *Pistia* sp; groves of *Mauritia* palms,and swamp forest with *Calycophyllum spruceanum, Ficus insipida* and *Ogodeia* sp. In a region of relatively undisturbed humid tropical forest.
Land tenure: Almost entirely state owned, with some small private holdings.
Protection: Within the Amacayacu National Park (170,000 ha) established in 1975.
Land use: Some settlement and primitive cultivation along the river banks by indigenous groups; subsistence hunting and fishing.
Waterfowl: A variety of species typical of western Amazonia were observed during a brief survey in September 1976, including *Phalacrocorax olivaceus, Pilherodius pileatus, Butorides*

striatus, Egretta alba, Ardea cocoi, Anhima cornuta, Jacana jacana, Charadrius collaris, Phaetusa simplex, Sterna superciliaris and *Rynchops niger.*
Other fauna: Birds of prey observed in September 1976 included *Pandion haliaetus, Leptodon cayanensis* and *Busarellus nigricollis.* Mammals recorded for the Park include the manatee *Trichechus inunguis* and an otter *Lutra* sp; reptiles include *Melanosuchus niger* and *Eunectes murinus gigas.*
Threats: Colonization along the river banks, and ensuing destruction of riverine habitat and increased persecution of wildlife.
Research and conservation: The wetland habitats of Amacayacu National Park probably do not differ significantly from those of comparable areas in much of western Amazonia. The area is however still relatively undisturbed, and must rank as a good example of this complex of wetland communities, particularly at the National level.
References: IUCN (1982).
Source: Derek A. Scott.
Criteria for inclusion: 3a.

Lake Tota (20)

Location: 5°32'N, 72°56'W; 45 km east of Tunja, Boyaca Department.
Area: 5,620 ha.
Altitude: 3,015m.
Province and type: 8.34.12; 12 & 16.
Site description: A permanent freshwater Andean lake, up to 67m deep, with fringing marshes, wet meadows and arable land. The level of the lake has been lowered, and much of the original marsh vegetation converted into meadows.
Principal vegetation: Large beds of submergent *Elodea* sp, and floating *Myriophyllum brasiliense, Azolla filiculoides, Lemna minor* and *Ricciocarpus* sp; marshes in shallow bays with *Typha latifolia, Scirpus californicus* and some *Cortaderia* sp; and bogs with *Hydrocotyle ranunculoides, Polygonum punctatum, Rumex* sp and *Juncus* sp. The surrounding land is largely under cultivation, with some *Eucalyptus* and conifer plantations, and patches of the native humid montane forest.
Land tenure: Privately owned.
Protection: None.
Land use: Trout fishing; tourist recreation including sailing and water skiing; cutting of reeds for thatching and mattress making; and utilization of water for irrigation and domestic consumption by 22,000 people in the surrounding villages. There are several hotels on the lake shore.
Waterfowl: One of the most important lakes for waterfowl in the Colombian Andes, still supporting healthy populations of most of the endemic species and subspecies of the region. The Colombian Grebe *Podiceps (nigricollis) andinus* appears however to be extinct. This grebe was abundant when first collected in 1945, and was subsequently found on several lakes in the Bogota Savanna. However, by the late 1950s it was restricted to Lake Tota, and by 1968 the population was down to 300 birds. There are reliable records of odd individuals until 1977 (R. Ridgely), but none were located in thorough surveys in 1981 (J. Fjeldsa) and 1982 (Adams *et al*). In their survey in July and August 1982, Adams *et al* estimated breeding populations of other species as follows: *Podilymbus podiceps* 150-200 pairs; *Ixobrychus exilis bogotensis* 50-100 pairs; *Oxyura jamaicensis andina* 15-25 pairs; *Rallus semiplumbeus* 30-50 pairs; *Porphyriops melanops bogotensis* 40-50 pairs; *Porphyrula martinica* less than 25 pairs; and *Fulica americana columbiana* 500-600 pairs. Fjeldsa, in his survey of the previous year, estimated that there were 200 territories of *Rallus semiplumbeus* and 500-600 adult and juvenile *Porphyriops melanops. Gallinago nobilis* is common in the marshes, and a variety of lowland species have occurred at the lake as occasional visitors. *Anas discors, Porzana carolina* and *Actitis macularia* are common winter visitors from the Nearctic.
Other fauna: The marshes around the lake support an important population of the very local Apolinar's Marsh Wren *Cistothorus apolinari.* Adams *et al* estimated the breeding populationin 1982 to be between 30 and 50 pairs. Trout were introduced into the lake in the 1940s. Since then the endemic fish have virtually disappeared, and in 1981 local fishermen reported that

they catch only one or two a year. The invertebrate community has been described by Adams *et al.*

Threats: A variety of threats have been reported, including excessive hunting pressure, the extensive burning of marsh vegetation, harvesting of reeds, disturbance from tourism, the use of pesticides on adjacent agricultural land, and eutrophication caused by an inflow of domestic sewage and organic fertilizers. The introduction of trout undoubtedly had a drastic effect on the ecology of the lake, and the lowering of the water level in the past caused a reduction in the extent of the marshes, but no further reduction in water level is anticipated. Adams *et al* consider the lowering of the lake level and excessive hunting to be the principal causes for the decline in bird populations, but the introduction of trout must have been a contributing factor, and eutrophication and pollution may now pose the most serious threats.

Research and conservation: A number of studies have been conducted at the lake, the most thorough being those of Fjeldsa in 1981 and Adams *et al* in 1982. The latter authors made a variety of recommendations with regard to the conservation of the lake, including the creation of appropriate reserves, and the development of voluntary agreements between the local authorities and landowners to protect the shoreline.

References: IGAC (1977); Adams *et al* (1982); Adams & Slavid (1984).

Source: Jon Fjeldsa and Carolina Murcia.

Criteria for inclusion: 123.

Laguna de Fuquene (21)

Location: 5°32'N, 73°45'W; 100 km NNE of Bogota, Cundinamarca Department.

Area: c.4,000 ha.

Altitude: 2,510m.

Province and type: 8.34.12; 12.

Site description: A shallow freshwater lake and marshes in the Ubate Valley on the Bogota Savanna; a relict of the former Lake of Humboldt which has been decreasing in size since the Pleistocene. In recent decades the lake has been greatly reduced in size by drainage for agriculture, although it remains the largest wetland area on the Bogota Savanna. The water is used for irrigation, and the level now shows wide seasonal fluctuations.

Principal vegetation: Some submergent vegetation including *Potamogeton illinoiensis*; bedsof floating *Limnobium stoloniferum*, *Bidens laevis* and *Azolla* sp; and marshes with *Scirpus californicus*, *Hydrocotyle* sp, *Typha* sp and *Ludwigia* sp. Surrounded by extensive areas of wet pastureland.

Land tenure: A mixture of state and private ownership.

Protection: None.

Land use: Hunting, carp fishing, some reed-cutting and recreation; livestock rearing and agriculture in surrounding areas.

Waterfowl: Formerly a breeding area for *Podiceps (nigricollis) andinus*, *Anas georgica niceforoi* (both now extinct) and *Netta erythrophthalma erythrophthalma*, and an important wintering area for ducks, but relatively few birds now use the area. In October 1981, Fjeldsa recorded small numbers of *Podiceps dominicus*, *Ixobrychus exilis bogotensis*, *Bubulcus ibis*, *Egretta alba*, *Rallus semiplumbeus*, *Porphyriops melanops bogotensis*, *Fulica americana*, *Charadrius semipalmatus* and *Actitis macularia*.

Other fauna: Adams *et al* found several *Cistothorus apolinari* in the marshesin 1982, and thought that it might be commoner here than at Lake Tota. Fjeldsa also recorded *Agelaius icterocephalus bogotensis* in the marshes. Various fishes including carp and trout have been introduced into the lake.

Threats: Hunting pressure is extreme and it appears that at times there are more hunters than birds. The drainage of the marshes continues, and there is a very high siltation rate as a result of soil erosion in the surrounding watershed.

Research and conservation: Very little information is available except for the reports of brief visits by Fjeldsa in 1981 and Adams *et al* in 1982. The lake remains one of the most important wetlands on the Bogota Savanna, and further sudies should be initiated as soon as possible to determine what steps if any might be taken to halt further deterioration.

References: Olivares (1967); Adams *et al* (1982).

Source: German Ignacio Andrade and Jon Fjeldsa.
Criteria for inclusion: 2a & 2b.

Laguna de Cucunuba (22)

Location: 5°17'N, 73°48'W; 70 km northeast of Bogota, Cundinamarca Department.
Area: 35 ha.
Altitude: 2,640m.
Province and type: 8.34.12; 12.
Site description: A shallow freshwater lake and marshes on the Bogota Savanna; once a part of Laguna de Fuquene and a relict of the large Pleistocene Lake of Humboldt. The water level is subject to wide seasonal fluctuations, and the lake dries out completely in the dry season. Much of the surrounding marshland has been drained for pasture; the lake is now greatly reduced in size, and there is little open water.
Principal vegetation: Large areas of floating *Limnobium* sp and *Azolla* sp; and marshes with *Scirpus californicus* and *Typha* sp.
Land tenure: Privately owned.
Protection: None.
Land use: The waters of the lake are used for irrigation; and there is some reed-cutting, hunting, and livestock grazing in the marshes.
Waterfowl: Presumably the lake once supported breeding populations of most of the waterfowl of the Bogota Savanna, but with the reduction in extent of open water, several species have disappeared. In October 1981, Fjeldsa observed small numbers of *Podilymbus podiceps, Ixobrychus exilis bogotensis, Rallus semiplumbeus* and *Porphyriops melanops bogotensis.*
Other fauna: *Agelaius icterocephalus bogotensis* is common and *Cistothorus apolinari* occurs in the marshes.
Threats: Drainage for pasture continues; there is heavy hunting pressure; and the lake is silting up as a result of serious soil erosion in the surrounding hills.
References: Olivares (1967).
Source: German Ignacio Andrade and Jon Fjeldsa.
Criteria for inclusion: 2a.

Laguna de Suesca (23)

Location: 5°10'N, 73°47'W; 60 km northeast of Bogota, Cundinamarca Department.
Area: 300 ha.
Altitude: 2,640m.
Province and type: 8.34.12; 12.
Site description: A permanent freshwater glacial lake with fringing marshes.
Principal vegetation: A little floating vegetation, and some marshes with *Scirpus* and *Typha.*
Land tenure: State owned.
Protection: None.
Land use: Hunting, fishing and reed-cutting; livestock grazing, some cultivation and *Eucalyptus* plantations in surrounding areas.
Waterfowl: Very few waterfowl occur at present, mainly *Porphyriops melanops bogotensis* and *Fulica americana.*
Other fauna: No information.
Threats: Heavy hunting pressure, and some pollution and eutrophication.
Research and conservation: In view of its size and lack of serious threats, this is potentially one of the most important wetlands on the Bogota Savanna, but as long as intensive hunting is permitted, the lake is unlikely to support much wildlife.
References: Olivares (1967); Adams *et al* (1982).
Source: German Ignacio Andrade.
Criteria for inclusion: 3a.

Embalse de Neusa (24)

Location: 5°10'N, 73°58'W; 50 km north of Bogota, Cundinamarca Department.
Area: 750 ha.
Altitude: 2,890m.
Province and type: 8.34.12; 15.
Site description: A reservoir, built in 1951, with widely fluctuating water levels and a highly mobile shoreline. There are some marshes, particularly at the north end.
Principal vegetation: Extensive beds of *Elodea* sp, and some reedbeds. Much of the watershed is heavily forested with *Cupressus* and *Pinus* spp.
Land tenure: State owned.
Protection: None.
Land use: Water supply; fishing; and recreation including camping and water sports. The area is a very popular resort for people from Bogota, with upto 1,000 cars present at weekends.
Waterfowl: A variety of waterfowl have been recorded including breeding *Podilymbus podiceps, Anas flavirostris, Oxyura jamaicensis andina, Porphyriops melanops bogotensis* and *Fulica americana.* Common Nearctic migrants include *Anas discors, Tringa solitaria, T. melanoleuca* and *Actitis macularia.*
Other fauna: The dipper *Cinclus leucocephalus* occurs on nearby streams.
Threats: Eutrophication caused by agricultural run-off, and excessive disturbance from tourist recreation, particularly at weekends, seem to be the only threats.
Research and conservation: The area has great potential as a multipurpose nature conservation and public recreation area. Gast has recommended that disturbance free sanctuaries be created, that grazing by cattle and sheep be limited, and that the aquatic vegetation be managed to improve the habitat for waterfowl.
References: Gast (1979); Adams *et al* (1982).
Source: See references.
Criteria for inclusion: 2b.

La Florida Marshes (25)

Location: 4°45'N, 74°10'W; near El Dorado Airport, Bogota, Cundinamarca Department.
Area: 100 ha.
Altitude: 2,550m.
Province and type: 8.34.12; 13.
Site description: A complex of shallow freshwater ponds, up to 2.5m deep, and marshes on the flood plain of the Rio Bogota.
Principal vegetation: Ponds with beds of submergent *Potamogeton* sp, and floating *Limnobium* sp and *Azolla* sp; marshes with species of *Scirpus* and *Typha.*
Land tenure: A mixture of state and private ownership.
Protection: No habitat protection. A part of the area is included in the "Parque de la Florida", a public recreation area.
Land use: Public recreation. One of the ponds is used for boating; a road bisects the marshes; and there is a golf course nearby.
Waterfowl: Despite the proximity of the site to Bogota, and the considerable disturbance from recreation, the ponds and marshes support a wide variety of waterfowl in significant numbers. Twenty-five species have been recorded including *Ixobrychus exilis bogotensis, Nycticorax nycticorax, Bubulcus ibis, Anas cyanoptera, A. discors, Oxyura jamaicensis andina, O. dominica, Rallus semiplumbeus, Porzana carolina, Porphyriops melanops bogotensis* (up to 130), *Gallinula chloropus* (up to 150), *Fulica americana, Gallinago nobilis* and five species of Nearctic shorebirds.
Other fauna: There is a large population of *Agelaius icterocephalus bogotensis*, and thereare several pairs of *Cistothorus apolinari.*
Threats: There is considerable pollution in the Rio Bogota, and a Government proposal exists to control the flooding of the river and eventually drain the entire area.
Research and conservation: The marshes remain one of the most important wetlands in the Bogota Savanna, and would be an ideal site for a conservation education programme.
References: Olivares (1967); Adams *et al* (1982).

Source: Juan Gonzalo Arango, German Ignacio Andrade and Jon Fjeldsa.
Criteria for inclusion: 2a & 3a.

Funza Marshes (26)

Location: 4°40'N, 74°10'W; near Funza, west of Bogota, Cundinamarca Department.
Area: 30 ha.
Altitude: 2,550m.
Province and type: 8.34.12; 13.
Site description: A complex of shallow freshwater ponds, up to 2.5m deep, and marshes on the flood plain of the Rio Bogota.
Principal vegetation: Marshes with species of *Scirpus* and *Typha.*
Land tenure: A mixture of state and private ownership.
Protection: None.
Land use: Hunting and livestock grazing.
Waterfowl: Small populations of *Ixobrychus exilis bogotensis, Nycticorax nycticorax, Rallus semiplumbeus, Laterallus exilis, Porphyriops melanops bogotensis, Porphyrula martinica* and *Fulica americana. Porzana carolina* is a winter visitor.
Other fauna: Populations of *Cistothorus apolinari* and *Agelaius icterocephalus bogotensis.*
Threats: Canalization and filling in of the marshes; and pollution with domestic sewage from the Rio Bogota. There is a Government project to control the flooding of the Rio Bogota and eventually drain the marshes completely.
References: Olivares (1967).
Source: Juan Gonzalo Arango.
Criteria for inclusion: 2a.

Laguna de La Herrera (27)

Location: 4°40'N, 74°16'W; 15 km west of Bogota, Cundinamarca Department.
Area: 350 ha.
Altitude: 2,550m.
Province and type: 8.34.12; 12.
Site description: A permanent shallow freshwater lake, up to 3m deep, with extensive marshes on the Bogota Savanna. A relict of the much larger Pleistocene Lake of Humboldt. The lake and marshes were greatly reduced by drainage schemes in the early 1970s.
Principal vegetation: Extensive beds of floating vegetation and muddy areas with species of *Azolla, Limnobium, Ludwigia* and *Hydrocotyle*; marshes with *Scirpus californicus* and *Typha* sp.
Land tenure: A mixture of state and private ownership.
Protection: None.
Land use: Hunting and reed-cutting; livestock grazing and agriculture in surrounding areas.
Waterfowl: Formerly an extremely important wetland for waterfowl of the Bogota Savanna and a breeding site for *Podiceps (nigricollis) andinus, Anas georgica niceforoi* and *Netta erythrophthalma erythrophthalma*, but much reduced in importance in recent years. A wide variety of species still occur including *Ixobrychus exilis bogotensis, Bubulcus ibis* (roost of up to 1,100), *Egretta caerulea, E. thula, Rallus semiplumbeus* (common), *Porphyriops melanops bogotensis* (up to 50), *Porphyrula martinica* and *Gallinago nobilis. Anas discors, Porzana carolina* and several Nearctic shorebirds are common winter visitors.
Other fauna: There is a small population of *Cistothorus apolinari*, and *Agelaius icterocephalus bogotensis* is common.
Threats: Progressive drainage for pasture land, pollution from the Rio Bogota, destruction of marsh vegetation by cattle, excessive hunting, and the development of limestone quarries on the west side of the lake have been the principal threats. However, there is now a Government project to control the flooding of the Rio Bogota which would destroy the wetland completely.
Research and conservation: Despite its diminished size, Laguna de La Herrera remains one of the most important wetlands on the Bogota Savanna, and could still be restored to something

approaching its original condition. Apparently a proposal has already been made for the establishment of a reserve, but no action has been taken. Studies are urgently required to determine what might be done to conserve the area before it is lost completely in the proposed flood control project for the Rio Bogota.
References: Olivares (1967); Adams *et al* (1982).
Source: Juan Gonzalo Arango, German Ignacio Andrade and Jon Fjeldsa.
Criteria for inclusion: 2a, 2b & 3a.

Laguna de Pedropalo (28)

Location: 4°40'N, 74°20'W; 25 km west of Bogota, on the east side of the Santa Magdalena valley, Cundinamarca Department.
Area: 60 ha.
Altitude: 2,100m.
Province and type: 8.34.12; 12.
Site description: A small permanent freshwater lake, up to 30m deep, with fringing marshes and stable water level.
Principal vegetation: One third of the lake surface is covered with *Lemna* sp, and there are fringing marshes of *Typha* and *Scirpus.* In a region of subtropical cloud forest.
Land tenure: Privately owned.
Protection: None.
Land use: Hunting. There is some cultivation in the surrounding area.
Waterfowl: There is a large population of *Podiceps dominicus* and small populations of *Oxyura jamaicensis andina, Porphyriops melanops bogotensis* and *Fulica americana. Porzana carolina* occurs in winter.
Other fauna: *Cistothorus apolinari* is thought to occur. There are very high densities of amphipods in the lake, and trout have been introduced.
Threats: Excessive hunting, and the introduction of trout.
References: Olivares (1967).
Source: German Ignacio Andrade and Jon Fjeldsa.
Criteria for inclusion: 2a & 3a.

Laguna de San Ramon (29)

Location: 4°35'N, 74°10'W; west of Bogota, Cundinamarca Department.
Area: Several hundred ha.
Altitude: 2,700m.
Province and type: 8.34.12; 15.
Site description: A permanent artificial lake, up to 2m deep, with stable water level and narrow fringing marshes, in pastureland on the Bogota Savanna.
Principal vegetation: Fringing marshes and shrubbery.
Land tenure: Privately owned.
Protection: No legal protection, but the owners prohibit hunting.
Land use: Livestock grazing and ornamental gardening in the surrounding areas.
Waterfowl: During a brief visit in October 1981, Fjeldsa observed 18 adult *Oxyura jamaicensis andina* with seven pulli. This subspecies, which is confined to the Andes of Colombia, is declining throughout its range and is now rare. Other breeding species included *Podilymbus podiceps, Porphyriops melanops bogotensis* and *Fulica americana columbiana.*
Other fauna: *Agelaius icterocephalus bogotensis* was observed in October 1981.
Threats: None known.
Research and conservation: One of the few wetlands on the Bogota Savanna which is neither seriously threatened nor disturbed by hunters.
Source: Jon Fjeldsa.
Criteria for inclusion: 2a.

Laguna Chingaza (30)

Location: 4°30'N, 73°50'W; between Alto La Bandera and Villaguardia, Cundinamarca Department.
Area: 150 ha.
Altitude: 3,300m.
Province and type: 8.34.12; 12 & 19.
Site description: A permanent freshwater glacial lake, over 10m deep, with surrounding bogs, in the paramo zone.
Principal vegetation: A little submergent *Ranunculus kunthianus*; bogs with species of *Carex*, *Chusquea* and *Sphagnum*; in a region of paramo vegetation and temperate cloud forest.
Land tenure: Approximately 90% of the National Natural Park is state owned; the rest is privately owned.
Protection: Within the Chingaza National Natural Park (50,000 ha) established in 1977.
Land use: The water is used for human consumption.
Waterfowl: Breeding species observed during a brief visit in October 1981 included *Anas flavirostris, Rallus semiplumbeus, Fulica americana columbiana, Gallinago nobilis* and *G. stricklandii jamesoni.*
Other fauna: *Cinclus leucocephalus* occurs along nearby streams, and the Mountain Tapir *Tapirus pinchaque* occurs in the area.
Threats: None known.
References: IUCN (1982).
Source: Jon Fjeldsa.
Criteria for inclusion: 2a & 3a.

Laguna del Otun (31)

Location: 4°47'N, 75°26'W; 30 km SSE of Manizales in the Cordillera Central, Risaralda Department.
Area: 150 ha.
Altitude: 3,980m.
Province and type: 8.33.12; 12 & 19.
Site description: A permanent freshwater lake of glacial origin, with surrounding bogs; in the high Andean paramo zone. The lake receives it water from snow melt on Nevado de Santa Isabel.
Principal vegetation: Paramo vegetation with *Espeletia* sp and the grasses *Calamagrostis* and *Festuca.*
Land tenure: No information. (60% of the land in the National Park is state owned, the rest is privately owned.)
Protection: Within Los Nevados National Natural Park (38,000 ha) established in 1977.
Land use: Sport fishing. Some agriculture nearby.
Waterfowl: The lake supports important breeding populations of *Anas flavisrostris andium, Oxyura jamaicensis andina* and *Fulica americana. Gallinago stricklandii jamesoni* occurs in the surrounding bogs, and *Merganetta armata* on nearby rivers and streams. Several Nearctic migrants occur on passage, particularly *Anas discors.*
Other fauna: The Mountain Tapir *Tapirus pinchaque* and Spectacled Bear *Tremarctos ornatus* are thought to occur in the area. The trout *Salmo gairdnieri* has been introduced into the lake.
Threats: The introduction of trout has affected the ecology of the lake, and there have been some modifications to the wetland as a result of road construction. Adjacent agriculture and occasional fires on the paramo may be causing problems.
Research and conservation: The Sociedad Caldense de Ornitologia in Manizales has conducted bird censuses at the lake.
References: IUCN (1982).
Source: Jorge E. Botero.
Criteria for inclusion: 3a.

Laguna de Sonso (32)

Location: 3°52'N, 76°21'W; 3 km west of Buga, Valle Department.
Area: 594 ha permanently flooded.
Altitude: 935m.
Province and type: 8.33.12; 11, 12, 17 & 18.
Site description: A permanent shallow freshwater lake and marshes adjacent to the Rio Cauca, and part of an old natural system of seasonal lakes and marshes along the Rio Cauca. Most of the seasonal marshes have now been drained for agriculture and pasture land. There are some small remnants of native swamp forest.
Principal vegetation: Patches of swamp forest with *Erythrina poeppigiana, E. glauca* and *Anacardium excelsum.*
Land tenure: A mixture of state and private ownership.
Protection: The permanently flooded areas and surrounding marshes are included within a Nature Reserve administered by the Corporacion Autonoma Regional del Cauca.
Land use: Traditional fishing and some tourism. Cattle ranching and intensive agriculture in surrounding areas.
Waterfowl: A very important wetland for waterfowl, with a wide variety of breeding species and winter visitors. Residents include *Anhinga anhinga, Botaurus pinnatus, Nycticorax nycticorax, Egretta caerulea, Ardea cocoi, Anhima cornuta, Dendrocygna bicolor, D. autumnalis, Oxyura dominica, Rallus nigricans, R. maculatus, Porphyrula martinica, Jacana jacana* and *Himantopus himantopus.* Nearctic migrants include *Ixobrychus exilis, Butorides virescens, Anas discors, A. cyanoptera* and several shorebirds.
Other fauna: *Pandion haliaetus* is a regular winter visitor.
Threats: Drainage ditches have been dug through the marshes, and some of the springs have been blocked off. Sedimentation rates have increased and eutrophication is occurring as a result of agricultural activities, and there is some industrial pollution.
Research and conservation: The Corporacion Autonoma Regional del Cauca has conducted studies on the hydrology of the area and management of the vegetation; and Naranjo is currently undertaking a study of the small population of *Anhima cornuta.*
References: Corporacion Autonoma Regional del Cauca (1981).
Source: Luis German Naranjo.
Criteria for inclusion: 2b & 3a.

Rio Cauca marshes (33)

Location: 4°05'N, 76°18'W to 3°18'N, 76°30'W; between Jamundi and Tulua on the Rio Cauca, Valle Department.
Area: 100 km of river.
Altitude: 970-975m.
Province and type: 8.33.12; 09, 11 & 18.
Site description: A series of thirteen permanent freshwater oxbow lakes, up to 4m deep, and associated marshes along the Rio Cauca, with remnants of the native swamp forest. The lakes increase in extent during the rainy season with flooding from the Rio Cauca.
Principal vegetation: Marshes with *Typha angustifolia, Eichhornia crassipes* and *Pistia stratiotes*; patches of swamp forest with *Erythrina* spp, *Anacardium excelsum, Ceiba pentandra, Clorophora tinctoria* and *Gustavia occidentalis.*
Land tenure: Privately owned.
Protection: No habitat protection. The Corporacion Autonoma Regional del Cauca is responsible for prohibiting hunting.
Land use: Traditional fishing; cattle ranching and agriculture in adjacent areas.
Waterfowl: An important chain of wetlands for waterfowl, with an avifauna similar to that of Laguna de Sonso (32).
Other fauna: No information.
Threats: Drainage for agriculture; eutrophication caused by agricultural run-off; pollution from the Rio Cauca and from pesticides used on adjacent agricultural land; and illegal hunting.

Research and conservation: The Corporacion Autonoma Regional del Cauca has done some studies in the area.
References: Corporacion Autonoma Regional del Cauca (1981).
Source: Luis German Naranjo.
Criteria for inclusion: 2b & 3a.

Rio Cali (34)

Location: 3°30'N, 76°40'W; 10 km west of Cali, Valle Department.
Area: Unknown.
Altitude: 2,000m.
Province and type: 8.33.12; 10.
Site description: A fast-flowing mountain river with a rocky bottom, and rocky and sandy shores. During the rainy season, the flow increases considerably.
Principal vegetation: The river flows through remnants of the native humid low montane forest, and cleared areas with cultivation and plantations of *Eucalyptus* and *Cupressus*.
Land tenure: A mixture of state and private ownership.
Protection: The Corporacion Autonoma Regional del Cauca is responsible for protecting the area, and hunting and wood-cutting are prohibited.
Land use: An important water source for the city of Cali. There is some sport fishing and tourist recreation along the river, and cattle ranching and agriculture in adjacent areas.
Waterfowl: The river supports a breeding population of *Merganetta armata.*
Other fauna: *Cinclus leucocephalus* nests along the river, and the native forests support a variety of species which are dependent on this natural riverine habitat, including *Rupicola peruviana, Sayornis nigricans* and *Serpophaga cinerea.*
Threats: Forest clearance for agriculture continues despite efforts to protect the watershed and maintain a pure water supply for Cali. A recent prolonged drought has accelerated soil erosion in the area.
References: Espinal (1968).
Source: Carolina Murcia.
Criteria for inclusion: 2b & 3a.

Laguna San Rafael (35)

Location: 2°25'N, 76°22'W; 30 km east of Popayan, Cauca Department.
Area: 100 ha.
Altitude: 3,200m.
Province and type: 8.33.12; 10, 12 & 19.
Site description: A permanent freshwater lake, surrounding peat bogs, and nearby fast-flowing mountain streams, at the source of the Cauca and Magdalena rivers, in the high Andes. The lake is considerably reduced in extent during the dry season.
Principal vegetation: In a region of paramo vegetation and elfin cloud forest, with abundant *Espeletia* sp, and species of *Weinmania, Clusia, Persea, Blechnum, Cortaderia, Senecio, Puya, Eryngium, Sphagnum* and *Polytrichum.*
Land tenure: State owned.
Protection: Within the Purace National Park (83,000 ha), established in 1961 and extended in 1977. Hunting and fishing are prohibited.
Land use: Livestock grazing and some subsistence hunting and wood-cutting by the inhabitants of small settlements in the Park; and some tourism.
Waterfowl: *Anas flavirostris* occurs on the lake, and *Merganetta armata* on the rivers and streams. *Anas discors* occurs on migration.
Other fauna: The Park has a rich mammalian fauna including the Spectacled Bear *Tremarctos ornatus* and Mountain Tapir *Tapirus pinchaque*, and it is possible that some condors *Vultur gryphus* still occur.
Threats: Illegal hunting and wood-cutting by the inhabitants of the Park.

Research and conservation: The Park is of particular importance in that it affords some protection to the upper watersheds of the Cauca and Magdalena Rivers.
References: IGAC (1977).
Source: Carolina Murcia.
Criteria for inclusion: 2b & 3a.

Laguna de La Cocha (36)

Location: 1°05'N, 77°10'W; 10 km southeast of Pasto, Nariño Department.
Area: 4,200 ha.
Altitude: 2,700m.
Province and type: 8.33.12; 12.
Site description: A permanent freshwater lake of volcanic origin, fed by several rivers and with a small island.
Principal vegetation: In the humid montane forest zone.
Land tenure: No information.
Protection: The lake itself is unprotected, but the island is protected in La Corota Floral Sanctuary, administered by INDERENA and the University of Nariño.
Land use: Trout fishing; recreation.
Waterfowl: There is a small population of *Podiceps occipitalis*, possibly the only population of this species still surviving in Colombia. *Anas flavirostris* also occurs.
Other fauna: No information.
Threats: No information.
Research and conservation: One of the few significant lakes in the southern Andes of Colombia and the largest, but apparently very poorly known.
References: IGAC (1977).
Source: Carolina Murcia.
Criteria for inclusion: 2b.

Laguna del Trueno (or Piusbi) (37)

Location: 1°55'N, 77°50'W; 100 km northwest of Pasto, Nariño Department.
Area: 2,000 ha.
Altitude: 150m.
Province and type: 8.3.1; 12.
Site description: A permanent freshwater lake with a large island, near the Rio Patia in the western foothills of the Andes.
Principal vegetation: In virgin humid tropical forest.
Land tenure: No information.
Protection: None.
Land use: No information. A very remote area, inaccessible by road and undoubtedly little disturbed.
Waterfowl: No information.
Other fauna: No information.
Threats: No information, but probably none.
Research and conservation: The only significant lake in the humid tropical forests of southwestern Colombia, but very difficult of access and apparently never surveyed.
References: IGAC (1977).
Source: Carolina Murcia.
Criteria for inclusion: 0.

Delta marshes of the Rio San Juan and Rio Baudo (38)

Location: 4°00'-5°30'N, 77°15'-77°30'W; on the Pacific coast from Bahia de Malaga to Cabo Corrientes, 10-170 km north of Buenaventura, Choco Department.
Area: c.220,000 ha.
Altitude: 0m.
Province and type: 8.3.1; 01, 02, 06, 07, 08, 09, 11 & 18.
Site description: A vast complex of coastal marshes including Bahia de Malaga, the delta of the Rio San Juan, and the estuaries of a number of smaller rivers including the Rio Baude, north to Cabo Corrientes. Wetland habitats include extensive intertidal mudflats, particularly in Bahia de Malaga; brackish coastal lagoons and marshes; mangrove swamps; slow-flowing rivers and riverine marshes; and swamp forest.
Principal vegetation: In a region of very humid tropical forest.
Land tenure: No information.
Protection: None.
Land use: No information.
Waterfowl: No information is available, but the avifauna is likely to be similar to that of Bahia de Buenaventura (39).
Other fauna: No information.
Threats: No information.
Research and conservation: Very little information is available on this large and remote coastal wetland complex. The Fundacion Herencia Verde has recently conducted an avifaunal survey of the area, but the results have not yet been published.
Source: Derek A. Scott.
Criteria for inclusion: 0.

Bahia de Buenaventura (39)

Location: 3°50'N, 77°10'W; at Buenaventura, Valle Department.
Area: c.20,000 ha.
Altitude: 0m.
Province and type: 8.3.1; 01, 02, 03, 05, 06, 08 & 09.
Site description: A shallow sea bay and estuarine system of several rivers, with small offshore islands, sandy beaches, intertidal mudflats and extensive mangrove swamps.
Principal vegetation: Mangrove swamps with *Avicennia germinans, Laguncularia racemosa, Pelliciera rhizophorae* and *Rhizophora* spp. In a region of very humid tropical forest.
Land tenure: A mixture of state and private ownership.
Protection: None.
Land use: The city of Buenaventura, which has the largest port on the Pacific coast of Colombia, lies at the east end of the bay, and there is a considerable amount of boat traffic in the bay. Other activities include fishing, hunting, wood-cutting and tourist recreation.
Waterfowl: A very important area for both breeding and wintering waterfowl. Resident breeding species include *Pelecanus occidentalis, Phalacrocorax olivaceus, Nycticorax nycticorax, Nyctanassa violacea, Egretta caerulea, E. thula, E. alba, Oxyura dominica, Charadrius wilsonius* and *Rynchops niger*. The area is particularly important as a wintering area for Nearctic shorebirds (thirteen species) and Laridae (eight species), but no census data are available.
Other fauna: *Pandion haliaetus* is a regular winter visitor. No information is available on the aquatic mammals or reptiles of the area.
Threats: Pollution from the city of Buenaventura and from shipping; indiscriminate cutting of mangroves; and excessive hunting.
Research and conservation: Naranjo *et al* have conducted a preliminary investigation of the avifauna of the bay, and Franke and Beltran commenced monthly censuses of shorebirds in July 1984.
References: Borrero (1968); Ralph & Chaplin (1973); Naranjo & Beltran *et al* (in press).
Source: Luis German Naranjo.
Criteria for inclusion: 3a.

Wetlands in Sanquianga National Natural Park (40)

Location: 2°22'-2°43'N, 78°06'-78°37'W; 100 km northeast of Tumaco, Nariño Department.
Area: c.100,000 ha.
Altitude: 0-100m.
Province and type: 8.3.1; 02, 03, 05, 06, 07, 08, 09 & 11.
Site description: A complex of estuaries and islands in the delta area of several rivers including Rio Sanquianga, with sandy beaches, coastal sand dunes, intertidal mudflats, tidal salt marshes, brackish lagoons, mangrove swamps, and some freshwater riverine marshes.
Principal vegetation: Mangroves with *Avicennia germinans, Laguncularia racemosa, Pelliciera rhizophorae* and *Rhizophora* spp. In the humid tropical forest zone.
Land tenure: Mainly state owned; about 10% of the National Park is in private holdings.
Protection: The greater part of the wetland area lies within Sanquianga National Natural Park (89,000 ha) established in 1977.
Land use: Selective exploitation of timber, and general wood-cutting by local inhabitants.
Waterfowl: Known to be an important area for migratory waterfowl, but no details are available. The avifauna is presumably similar to that of Bahia de Buenaventura (39).
Other fauna: The area is of great importance for fisheries production, particularly for species of *Arca*. The Capybara *Hydrochoerus hydrochaeris* occurs.
Threats: Excessive felling of timber.
Research and conservation: Little work has been done on the fauna and flora of the region.
References: IUCN (1982).
Source: See references.
Criteria for inclusion: 2c & 3a.

ECUADOR

INTRODUCTION

by **Fernando Ortiz**

Ecuador, the third smallest country in South America, has a surface area of 270,670km^2 and a population of over seven million. The country is divided into three distinct regions: the Pacific lowlands in the west, the Andes in the centre, and the lowlands of the Amazon basin in the east.

Although Ecuador lies on the equator, its climate is by no means uniformly hot and humid. Generally, two seasons can be identified; a winter season from December to May, with high temperatures and heavy rainfall, and a dry season during the rest of the year. However, in northern coastal regions and the Amazon lowlands there is heavy rainfall throughout the year.

Half of the country is covered in humid tropical forest. This oocurs throughout the lowlands of upper Amazonia, on the eastern slopes of the Andes, and in the coastal lowlands of the northwest. Further south along the coast, semideciduous forest gives way to arid tropical woodland and eventually, in the extreme south, to desertic scrub (matorral). In the Andes, humid temperate forest gives way at high altitude to Andean grassland and paramo vegetation.

A general review of the wetlands of Ecuador has recently been given by the author (Ortiz, 1983). M. Steinitz-Kannan and P. Colinvaux are using the lakes of Ecuador to test limnological hypotheses developed from studies of seasonal lakes at high latitudes. The great advantage of this selection of equatorial lakes for research is the coupling of minimal seasonal changes with immense variety. At close to zero latitude, there are glacial lakes of the paramo with a temperature range of 1°C to 16.8°C, and permanent lakes of the lowland rain forest with temperature ranges of 25.8°C to 28.2°C. Diurnal changes in temperature probably exceed annual changes. Lakes lie in deserts, in marshes of the coastal plain, and in montane cloud forest; they are virgin, or with long histories of disturbance; polymictic, oligomictic or with aberrant chemistry; occupying the basins of maars, river channels, grabens, calderas, kettles, and moraine-dammed fjords; behind volcanic dams, primary Andean landforms, and emergent coast lines. Ancient and permanent lakes have been discovered for the first time in the Amazon basin; one of them (Ayauchi), a blue-water oligotrophic lake with oxygen to 20m, has been isolated from rivers or flooding for seven thousand years (M. Steinitz-Kannan, pers. com.).

Institutional Base for Wetland Conservation and Research

The principal institutions concerned with wildlife conservation and research in Ecuador are as follows:

a) Ministerio de Agricultura y Ganaderia; Programa Nacional Forestal.
   Departamento de Areas Naturales y Vida Silvestre: the department responsible for the establishment and administration of national parks, natural recreation areas, ecological reserves and faunistic reserves. About 9.6% of the country is legally protected within this system of protected areas. The department is also the administrative authority for CITES in Ecuador.

b) Ministerio de Recursos Naturales; Subsecretaria de Recursos Pesqueros.
   Direccion General de Recursos Pesqueros: the agency that controls fishing activities both at sea and in freshwater bodies, and gives authorization for the construction of shrimp ponds.
   Instituto Nacional de Pesca: the institute responsible for fisheries research. Emphasis has been given to research on marine species, and the freshwater resources with no export potential have been neglected.
   Direccion General de Medio Ambiente.

c) Ministerio de Relaciones Exteriores; Direccion General de Soberania Maritima y Aerea; Departamento de Soberania Maritima.

Fundacion Charles Darwin: this began as an almost 100% foreign organization based in Europe, but is now about 75% Ecuadorean in its composition. The Foundation fosters conservation in the Galapagos Islands by promoting research and enlisting international support.

Estacion Charles Darwin: this was created in 1964 and is responsible for conducting research in the Galapagos Islands. In addition to its success in research, the Station has been instrumental in the creation of the Servicio del Parque Nacional Galapagos, which has become the best manned conservation unit in Ecuador.

d) Ministerio de Defensa.

Colegio Militar Eloy Alfaro: this Military School maintains a zoological garden in Quito.

Instituto Geografico Militar: this is the source of all official geographical information for Ecuador. The Institute houses the Center for Remote Sensing (CLIRSEN) which has conducted forest inventories in the Amazon watershed.

e) Universidad Central del Ecuador. (The largest and oldest university in Ecuador. All of the universities are autonomous, but receive financial support from the Government through the Ministry of Finance.)

Instituto de Ciencias Naturales: this Institute houses an herbarium and is the centre for botanical studies at the Central University. It publishes a journal "Ciencia y Naturaleza".

f) Universidad Estatal de Guayaquil.

Escuela de Biologia and Museo de Zoologià (Facultad de Ciencias Naturales): the only pure biology department in a natural science faculty in the country. The Faculty maintains an herbarium and a zoological collection, and is responsible for the operation of the recently established field station at Jauneche in humid tropical forest in Guayas Province.

g) Escuela Superior Politecnica del Litoral.

Departamento de Ciencias del Mar: this has conducted some projects dealing with environmental issues and some research on mangroves.

h) Pontificia Universidad Catolica del Ecuador.

Departamento de Biologia (Facultad de Pedagogia): this department maintains an herbarium and a zoological museum, and has collaborated for ten years with the Centro Cientifico Rio Palenque, where students can carry out field work in an area of humid tropical forest. The University produces a journal, "Revista de la Universidad Catolica" in which the Department of Biology publishes its work.

i) Consejo Nacional de Cultura; Casa de la Cultura Ecuatoriana.

Museo Ecuatoriano de Ciencias Naturales (Seccion Academica de Ciencias Biologicas y Naturales): created in 1979, the Museum maintains scientific collections and puts strong emphasis on public education through its exhibits. It is an autonomous entity nominally affiliated to the Casa de la Cultura.

j) Sociedad Ecuatoriana de Biologia. A society for professional biologists, organizing annual meetings and providing a link between individual biologists and government agencies.

k) Fundacion Natura. The largest private conservation body in Ecuador and one which has won the confidence of international oganizations. The Foundation obtains funds from agencies such as WWF, IUCN and US-AID, and supervizes the funding of conservation projects in Ecuador. It also conducts a campaign of environmental education through the media and has made a number of documentary films which have been shown throughout the country. In 1984, it initiated a programme of environmental education in primary and high schools which will run for four years and is expected to reach most schools. In late 1984, the Foundation established a sanctuary for Andean fauna and flora, the "Bosque Protector Pasochoa", near Quito.

Progress in Wetland Conservation

The following parks and reserves in the Sistema Nacional de Conservacion y Manejo de Areas Silvestres include significant areas of wetland:

Parque Nacional Cotopaxi: high Andean oligotrophic lakes, ancient glacial basins and associated bogs; comprising 5% of the total area of the park.

Parque Nacional Sangay: high Andean oligotrophic lakes, ancient glacial basins and associated bogs.

Parque Nacional Podocarpus: high Andean oligotrophic lakes, ancient glacial basins and associated bogs.
Area Nacional de Recreacion Cajas: high Andean oligotrophic lakes, ancient glacial basins and associated bogs.
Parque Nacional Machalilla: mangrove swamps; comprising 1% of the total area of the park.
Parque Nacional Yasuni: varzea forest and oxbow lakes along the Tiputini, Yasuni and Nashiño rivers; comprising 10% of the park. This region of humid tropical forest is one of the most important pleistocene refuges in Amazonia (the Napo Refuge).
Parque Nacional Galapagos: saline coastal lagoons, mangrove swamps and small freshwater lakes of volcanic origin in the Galapagos Islands.
Reserva Cotacachi-Cayapas: two oligotrophic lakes, Cuicocha and Cristococha (or Donoso de Piñan), with surrounding high Andean paramo. Cuicocha is in a volcanic crater and Cristococha is in a glacial basin.
Reserva Ecologica Cayambe-Coca: Lake San Marcos, Lake Purcianta and other high Andean oligotrophic lakes together with associated bogs; comprising 5% of the total area of the reserve.
Reserva Manglares Churute: mangrove swamps; comprising 50% of the total area of the reserve.
Reserva Faunistica Cuyabeno: a network of lakes which partially dry out during the dry season; comprising 50% of the total area of this humid tropical forest reserve in the Napo Refuge.

It is anticipated that wetlands will receive an adequate measure of protection if and when Ecuador ratifies the Ramsar Convention. The Fundacion Natura has requested the National Congress to take this step, and to implement adequate coordination between the Fundacion, the Departamento de Areas Naturales y Vida Silvestre in the Ministeria de Agricultura, and other governmental bodies which are responsible for wetlands, e.g. Direccion de Pesca, Instituto Ecuatoriano de Recursos Hidraulicos and Comandancia de Marina. On ratification of the Ramsar Convention, it would be possible for Ecuador to strengthen the protection of wetlands within its system of protected areas and also to provide a measure of protection to important wetlands outside the system, such as San Pablo, Yahuarcocha, Yambo and Colta lakes, and mangrove areas in the Santiago-Cayapas Delta, in Muisne-Cojimies, in the Portoviejo Delta and in the Gulf of Guayaquil (which contains 70% of the mangroves in coastal Ecuador).

Major Threats to Wetlands

The Fundacion Natura has pointed out that industrial and agricultural development constitute one of the most serious and immediate threats to wetlands both inland and on the coast. The Universidad Catolica has also drawn attention to the disappearance of wetlands, particularly along the coast, and considers this to be the most serious problem for conservation in Ecuador.

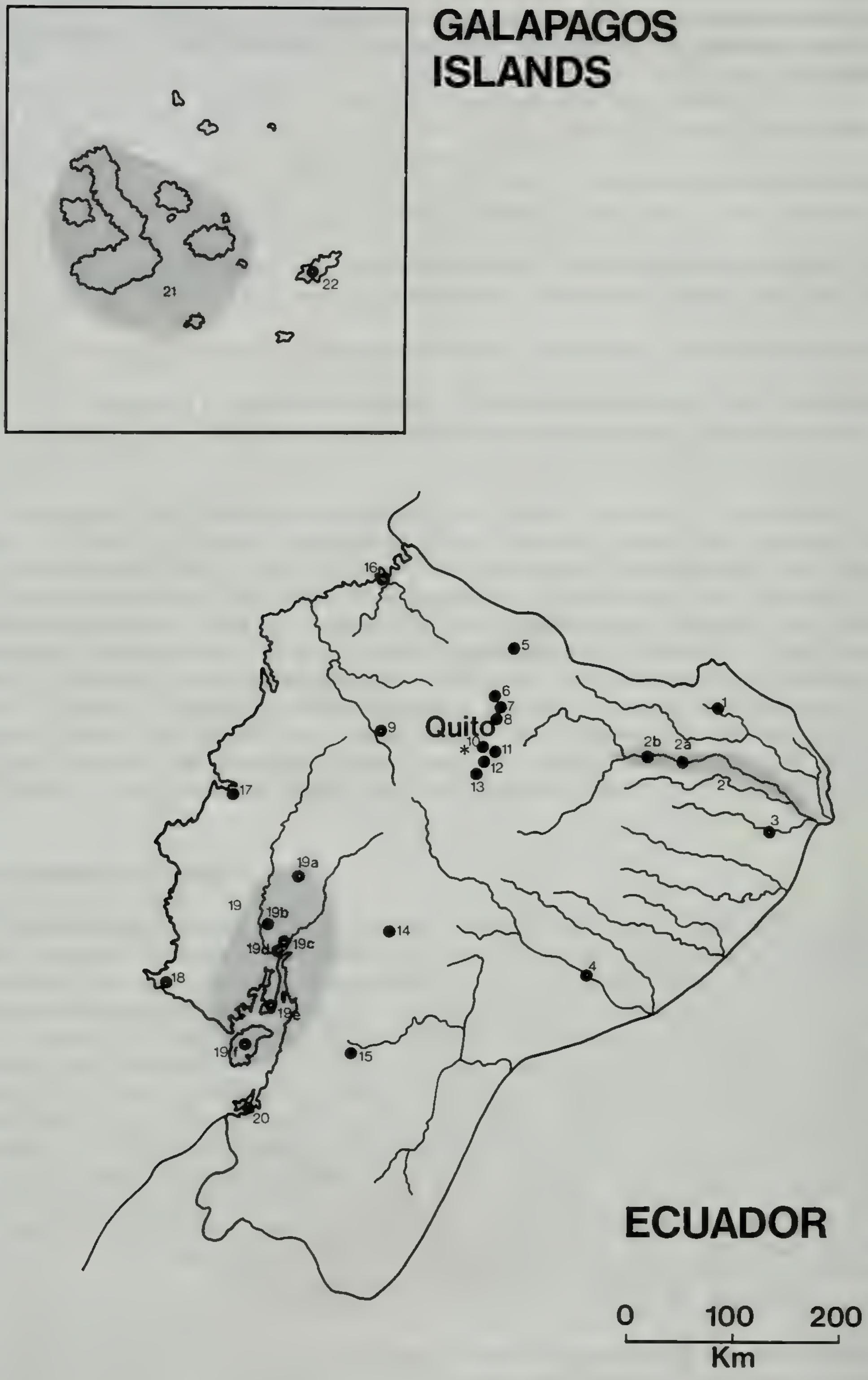
A number of major projects have recently been initiated to drain coastal wetlands for increased rice production and livestock rearing. Another serious problem is that posed by the explosive expansion of the shrimp industry along the coast. Recent information suggests that more than 20% of the mangroves have disappeared as a result of this expansion, and the remainder is seriously threatened. In addition, mangroves are gradually being chopped down for timber, charcoal and the extraction of tannin (E. Arellano, pers. com.). As a result of the uncontrolled expansion of shrimp ponds, there has been on increase in the occurrence of malaria, and it has become necessary to import pesticides to combat this problem.

In the Andes, large areas of native vegetation have been converted to pasture land. However, the most serious threats to wetlands are eutrophication, e.g at San Pablo, Yahuarcocha and Poza Honda lakes, and dessication, e.g. at Iñaquito-La Carolina and Yaguachi-Daule-Vinces.

The development of the petroleum industry in the Amazon basin has facilitated colonization by settlers with agricultural interests. Transportation networks have been expanded without regard for the boundaries of protected areas; this has been the case at, for example, the Reserva Faunistica Cuyabeno, where some pollution has already been observed (E. Asanza, pers. com.). This increasing activity in the Amazon region has been accompanied by widespread deforestation and transformation of wetland ecosystems.

Conservationists have not as yet been able to solve the problems facing wetlands, because

Ecuador lacks a proper wetlands conservation policy. The root of the problem lies in the lack of suitable expertize in the field. Very little is known of the size, distribution and characteristics of wetlands in Ecuador. It is essential that information be obtained on the role of wetlands both in terms of their importance for animal and plant species, and the influence they have on other environmental variables, and vice versa. There is almost no information on the use of the wetlands by the different species, or on the importance of adjoining areas for agriculture.


GALAPAGOS ISLANDS
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WETLANDS

Site descriptions based on data sheets provided by Fernando Ortiz, Clemencia Vela and Paul Greenfield, with contributions from Eduardo Asanza, Nancy Hilgert, Felix Man-ging, Robert S. Ridgely, Miriam Steinitz-Kannan and Carlos Valle.

Lagunas del Cuyabeno (1)

Location: 0°05'S, 76°10'W; west of Cuyabeno, Napo Province.
Area: Unknown.
Altitude: 280m.
Province and type: 8.5.1; 09, 11, 12 & 18.
Site description: A vast complex of freshwater lakes and marshes in the fluvial system of the Rio Cuyabeno; including thirteen main lakes and extensive areas of swamp forest.
Principal vegetation: Lakes with typical igapo vegetation; in a region of humid to very humid tropical forest.
Land tenure: State owned.
Protection: Within a faunal reserve, the "Reserva de Produccion Faunistica Cuyabeno", established in 1979. Figueroa (1983) gives the area as 254,760 ha.
Land use: Subsistence hunting and fishing by indigenous Indian groups; the Government has authorized petroleum exploration.
Waterfowl: One of the richest areas in Ecuador for waterfowl. Seventy species have been recorded, including virtually all of the waterfowl typical of western Amazonia, but no census data are available. Species of particular note include *Tigrisoma fasciatum, Zebrilus undulatus, Cochlearius cochlearius, Agamia agami*, all three Ciconiidae, *Anhima cornuta, Sarkidiornis melanotos, Amaurolimnas concolor, Porphyrula flavirostris, Heliornis fulica, Eurypyga helias* and *Gallinago undulata.* Thirteen species of Nearctic shorebirds have been recorded on migration.
Other fauna: The area has an extremely rich avifauna including a wide variety of birds of prey dependent on wetland habitats and all five South American kingfishers Alcedinidae. Other faunal elements are similarly well represented.
Threats: Although designated a Faunal Reserve, the area has no game wardens, hunting is unrestricted, and there are no controls to prevent habitat destruction. Illegal fishing methods are employed including dynamiting and poisoning. An Oil Company has constructed a network of roads for exploration in the Reserve, and there is oil pollution along the river banks and edges of lagoons.
Research and conservation: As in most of eastern Ecuador, very little work has been done on the fauna and flora other than some basic inventories. Asanza has recently produced a bird list for the area, but otherwise the Reserve remains very poorly known. The need for proper enforcement of the Reserve regulations is apparent.
References: Figueroa (1983); Asanza (undated).
Source: Fernando Ortiz, Clemencia Vela, Paul Greenfield and E. Asanza.
Criteria for inclusion: 2b & 3a.

The upper Rio Napo and tributaries (2)

Location: 0°30'S, 77°30'-75°20'W; Napo Province.
Area: Unknown.
Altitude: 200-330m.
Province and type: 8.5.1; 09, 11 & 18.
Site description: Slow-flowing rivers, riverine marshes, and associated oxbow lakes and swamp forest of the upper Rio Napo, Rio Suno, lower Rio Sumaco and Rio Aguarico. Two of the principal oxbow lakes, Limoncocha and Taracoa, are described separately below.
Principal vegetation: In humid to very humid tropical forest.
Land tenure: The rivers are state owned; the settled areas along the river banks are now privately owned.

Protection: None, but the region borders on the Yasuni National Park to the south.
Land use: Hunting, fishing, exploitation of timber and cultivation of oil palms.
Waterfowl: A very rich area for waterfowl species typical of western Amazonia. Some of the more noteworthy species known from the area include *Tigrisoma fasciatum, Pilherodius pileatus, Jabiru mycteria, Aramides calopterus, Anurolimnas castaneiceps, Laterallus fasciatus, Eurypyga helias* and *Hoploxypterus cayanus.*
Other fauna: No information.
Threats: Colonization by settlers along the river banks continues to erode the riverine habitats, particularly to the west of Coca, and a big oil palm plantation near Coca is likely to be extended in the future. Tree-felling is unrestricted, and there is some illegal use of dynamite and poisons (*Verbascum* and cyanide) in fishing activities.
Research and conservation: A considerable amount of basic survey work has been carried out at Limoncocha and Taracoa (see below), and Steinitz-Kannan *et al* (1983) conducted limnological studies at Lago Agrio and Laguna Santa Cecilia, two small oxbow lakes near the town of Lago Agrio. There remain, however, large tracts of the upper Rio Napo which are still very remote and poorly known.
References: Chapman (1926); Pearson (1972a); Pearson *et al* (1977); Steinitz-Kannan *et al* (1983).
Source: Fernando Ortiz, Clemencia Vela, Paul Greenfield and Robert S. Ridgely.
Criteria for inclusion: 2b & 3a.

Lago Limoncocha and the Rio Jivino (2a)

Location: 0°24'S, 76°37'W; on the Rio Napo, 40 km east of the confluence of the Rio Coca and Rio Napo, Napo Province.
Area: Lago Limoncocha 120 ha.
Altitude: 240m.
Province and type: 8.5.1; 09 & 11.
Site description: Lago Limoncocha is an old oxbow lake of the Rio Napo. The water level in the lake fluctuates according to rainfall in the eastern Andes, and according to the level in the nearby Rio Jivino, a small tributary of the Rio Napo which floods into the lake at high water levels.
Principal vegetation: In humid tropical forest (average annual rainfall 2,940 mm).
Land tenure: The lake is state owned; some of the surrounding land is owned by indigenous communities.
Protection: None.
Land use: Subsistence hunting and fishing, exploitation of timber, and tourism.
Waterfowl: A very rich oxbow lake for western Amazonian waterfowl, with sixty species recorded. The commoner species include *Anhinga anhinga, Butorides striatus, Ardea cocoi, Opisthocomus hoazin, Aramus guarauna, Heliornis fulica, Anurolimnas castaneiceps, Laterallus exilis, Porphyrula martinica, P. flavirostris, Jacana jacana* and *Hoploxypterus cayanus.* Fifteen species of Nearctic shorebirds have been recorded on passage, the commonest being *Tringa solitaria, Actitis macularia, Calidris bairdii* and *C. melanotos.*
Other fauna: Nearly 500 species of birds have been recorded in the Limoncocha area, along with a wide variety of Amazonian species of fishes, reptiles and amphibians. The local mammalian fauna has however suffered badly from hunting.
Threats: Uncontrolled hunting and fishing, and indiscriminate wood-cutting. There has been a tremendous increase in colonization by settlers in recent years, and there were reports of dynamiting for fishes in 1983.
Research and conservation: The fauna and flora of the lake and its surroundings have been well studied and documented. Limoncocha has become a popular locality for nature tourism, and a proposal has been made to designate the area as a faunal and floral reserve. However, no steps have as yet been taken to implement this, and destruction of the forests around the lake continues at an ever-increasing rate.
References: Pearson (1972a & 1972b); Pearson *et al* (1977); Ortiz (1983).
Source: Fernando Ortiz, Clemencia Vela and Paul Greenfield.
Criteria for inclusion: 3a.

Laguna Taracoa (2b)

Location: 0°26'S, 76°46'W; on the south bank of the Rio Napo, east of Coca, Napo Province.
Area: Unknown.
Altitude: 240m.
Province and type: 8.5.1; 11 & 18.
Site description: An old black water oxbow lake and inlet of the Rio Napo, with surrounding low-lying swamp forest and seasonally flooded palm forest. The lake is 2-3m deep.
Principal vegetation: Lake with abundant aquatic vegetation, swamps with *Mauritia* palms. In humid tropical forest.
Land tenure: State owned.
Protection: No legal protection, but a local tour company tries to prohibit hunting. The area borders on the Yasuni National Park to the east.
Land use: Tourism; and some hunting, fishing and exploitation of timber by a local Indian community. An oil company pumps water from the lake.
Waterfowl: A very rich lake for Amazonian waterfowl, with a fauna similar to that of Limoncocha. *Cochlearius cochlearius, Agamia agami* and *Anurolimnas castaneiceps* are fairly common.
Other fauna: Almost 500 species of birds have been recorded, including many which are not normally considered as waterfowl, but which are closely linked to forest streams, lake edge habitats and seasonally flooded "varzea" forest, e.g. the rather scarce hummingbird *Topaza pyra* which nests on limbs protruding over forest streams. A wide variety of Amazonian fishes, amphibians, reptiles and mammals occur, including *Caiman crocodilus* and *Melanosuchus niger.*
Threats: Oil exploration and the construction of a road to the west end of the lake has opened up the area to encroachment by local Indians and recent colonists. There have been rumours of the use of dynamite and poisons in fishing activities.
Research and conservation: Avifaunal surveys have been conducted by Greenfield. There are few areas in Ecuador with as rich a fauna and flora as Laguna Taracoa and which at the same time are as accessible for tourism. Unfortunately, the local tour company (Metropolitan Touring) has so far failed to secure rights over the land. The Government should therefore be encouraged to establish a reserve in this area, perhaps by extending the boundaries of the nearby Yasuni National Park.
Source: Fernando Ortiz, Clemencia Vela and Paul Greenfield.
Criteria for inclusion: 2a & 3a.

Wetlands in Yasuni National Park (3)

Location: 0°26'-1°09'S, 75°26'-76°41'W; along the Rio Yasuni and Rio Nashiño, 50 km west of Coca, Napo Province.
Area: Area of wetlands unknown.
Altitude: 200-250m.
Province and type: 8.5.1; 09, 11, 12 & 18.
Site description: The alluvial plains of the Rio Yasuni and Rio Nashiño, with numerous oxbow lakes and riverine marshes, freshwater lakes and swamps, and large areas of swamp forest.
Principal vegetation: In humid tropical forest.
Land tenure: State owned.
Protection: Within the Yasuni National Park (679,730 ha) established in 1979, but as the Park regulations are not enforced, the area is in effect unprotected.
Land use: Hunting, fishing, exploitation of timber, and oil exploration.
Waterfowl: A wide variety of western Amazonian waterfowl, including such characteristic species as *Anhinga anhinga, Ardea cocoi, Mesembrinibis cayennensis, Cairina moschata, Opisthocomus hoazin, Aramus guarauna, Heliornis fulica, Phaetusa simplex* and *Sterna superciliaris.*
Other fauna: A rich Amazonian fauna still largely intact, with large populations of crocodilians and cetaceans in the rivers.
Threats: Unrestricted squatting by settlers, with associated forest clearance, hunting and fishing. The construction of a network of roads for oil exploration has opened up the area to colonization, and the colonists have now formed their own organizations to pressure the Government into declassifying parts of the National Park for settlement. The Department of National Parks seems powerless to prevent this.

Research and conservation: Only preliminary faunal investigations have been carried out in the Park, but it is clear that the area is still very rich in wildlife. As Yasuni National Park constitutes almost the only protected area in the Amazonian region of Ecuador, every effort should be made to enforce the Park regulations and prevent further colonization in the area.
References: Vreugdenhil (1979); IUCN (1982).
Source: Fernando Ortiz, Clemencia Vela and Paul Greenfield.
Criteria for inclusion: 2a, 2b & 3a.

Rio Pastaza and tributaries (4)

Location: 1°30'-2°35'S, 76°40'-78°00'W; between Pastaza and the Peruvian border, Pastaza Province.
Area: 250 km of river.
Altitude: 250-800m.
Province and type: 8.5.1; 09, 11 & 18.
Site description: The Rio Pastaza and its tributaries, including Rio Bobonanza and Rio Rutuno, and the Sarayacu zone on the Rio Bobonanza. Wetland habitats include slow-flowing rivers, oxbow lakes and marshes, and swamp forest.
Principal vegetation: In humid tropical forest.
Land tenure: A mixture of state and private ownership.
Protection: None.
Land use: Primitive agriculture and livestock rearing around many small settlements; subsistence hunting and fishing.
Waterfowl: Little information available, but the area appears to support a very rich waterfowl community including a variety of uncommon species such as *Zebrilus undulatus*, *Neochen jubatus* and *Aramides calopterus*.
Other fauna: No information.
Threats: Human colonization proceeds at a rapid rate.
Research and conservation: The area is still very poorly known.
Source: Fernando Ortiz and Clemencia Vela.
Criteria for inclusion: 0.

Lago Yaguarcocha (5)

Location: 0°23'N, 78°05'W; north of Ibarra, Imbabura Province.
Area: 230 ha.
Altitude: 2,210m.
Province and type: 8.33.12; 12.
Site description: A permanent relatively shallow freshwater lake of volcanic origin and with hard alkaline eutrophic waters, at medium elevation in the Andes. The maximum depth is 9m, but there is a very wide littoral zone, and the level of the lake is apparently decreasing. The lake is fed by water from the Rio Tahuando and local rainfall; it never freezes.
Principal vegetation: Eighty-four species of phytoplankton have been recorded, the highest number from any lake in Ecuador.
Land tenure: State owned.
Protection: None.
Land use: There is an automobile race track around the lake.
Waterfowl: A variety of Andean waterfowl occur including up to 25 *Podiceps occipitalis*, 225 *Anas georgica*, 50 *Oxyura jamaicensis ferruginea*, 40 *Fulica americana/ardesiaca* and 22 *Larus serranus*. *Podilymbus podiceps* is common, and several Nearctic migrants occur on passage, including *Anas discors* and *Porzana carolina*. The very rare Southern Pochard *Netta erythrophthalma erythrophthalma* was observed on the lake as recently as February 1981.
Other fauna: No information.
Threats: The basin of the lake has been modified by the recent construction of an automobile race track around the lake. Erosion and siltation resulting from this have affected the shallow

areas of the lake, and a recently constructed channel between the lake and the Rio Tahuando is at least partly responsible for a lowering in water level, although climatic changes are also almost certainly involved.

Research and conservation: The limnology of the lake has been studied by Steinitz-Kannan *et al.*

References: Colinvaux & Steinitz (1980); Steinitz-Kannan *et al* (1983).

Source: Fernando Ortiz, Clemencia Vela and Paul Greenfield.

Criteria for inclusion: 3a.

Laguna Cuicocha (6)

Location: 0°18'N, 78°24'W; 55 km NNE of Quito in the Western Cordillera, Imbabura Province.

Area: 657 ha.

Altitude: 3,068m.

Province and type: 8.33.12; 12.

Site description: A deep freshwater volcanic crater lake with two large islands, on the slopes of Cotacachi Mountain. The largest lake in Ecuador, with clear oligotrophic waters up to 132m deep; in a closed basin with cliffs rising up to 400m above the water. The water level is maintained by snow melt and rainfall balanced by evaporation and seepage.

Principal vegetation: Beds of *Potamogeton* sp and *Myriophyllum* sp, and a narrow fringe of *Scirpus* sp. Seventy-nine species of phytoplankton have been recorded. The western island is covered in montane forest. In the paramo and humid montane scrub zone.

Land tenure: State owned.

Protection: Within the Cotacachi-Cayapas Ecological Reserve (204,420 ha) established in 1968 and increased to its present size in 1979.

Land use: Tourism; there is a restaurant and recreation area on the lake shore, and regular boats trips around the lake at weekends.

Waterfowl: There are small resident populations of *Podiceps occipitalis* (up to 44 adults) and *Fulica americana/ardesiaca.*

Other fauna: No information.

Threats: Motor boat trips cause a considerable amount of disturbance, particularly at weekends.

Research and conservation: Studies have been conducted on the limnology of the lake and the grebe population, and a management plan has been produced for the Ecological Reserve.

References: Ortiz (1977); Hilsenbeck (1979); Colinvaux & Steinitz (1980); IUCN (1982); Figueroa (1983); Steinitz-Kannan *et al* (1983).

Source: Fernando Ortiz and Clemencia Vela.

Criteria for inclusion: 3b.

Lago San Pablo (7)

Location: 0°13'N, 78°14'W; 5 km southeast of Otavalo, at the foot of Mt Imbabura, Imbabura Province.

Area: 620 ha.

Altitude: 2,661m.

Province and type: 8.33.12; 12.

Site description: A permanent freshwater lake, up to 48m deep and with a wide shallow littoral zone, occupying an ancient closed basin on an interandean plateau. The second largest lake in Ecuador; formerly oligotrophic, but now much polluted and becoming eutrophic.

Principal vegetation: Marshes with *Scirpus* sp; beds of submergent *Potamogeton* sp and *Ceratophyllum* sp; a variety of algae including *Microcystis aeruginosa* and *Lyngbya birgei*; and 74 species of phytoplankton including *Pediastrum boryanum* and *Scenedesmus quadricauda.*

Land tenure: State owned.

Protection: None, although the lake is near the northern border of the Cayambe-Coca Ecological Reserve.

Land use: Water sports, particularly sailing; hunting and fishing; reed-cutting for weaving; and utilization of the water for irrigation. There are many chalets, restaurants and a sailing club on the shores of the lake.
Waterfowl: Formerly an important lake for waterfowl and a locality for the rare *Netta erythrophthalma erythrophthalma*, but relatively few birds present in recent years. A census in September 1983 included 11 *Podilymbus podiceps*, 130 *Anas georgica*, breeding *Gallinula chloropus* and *Fulica americana ardesiaca*, and small numbers of four species of Nearctic shorebirds.
Other fauna: No information.
Threats: The lake is undergoing eutrophication as a result of pollution with domestic sewage from holiday homes and other facilities on the lake shore; and there is excessive disturbance from human activities in general.
Research and conservation: The limnology of the lake has been studied by Steinitz-Kannan *et al.*
References: Steinitz-Kannan *et al* (1983).
Source: Fernando Ortiz, Clemencia Vela, Paul Greenfield and Derek A. Scott.
Criteria for inclusion: 2b & 3a.

Laguna de San Marcos (8)

Location: 0°07'N, 78°25'W; on the northeast slopes of Cayambe Volcano, Napo Province.
Area: 39 ha.
Altitude: 3,414m.
Province and type: 8.33.12; 12.
Site description: A permanent freshwater lake, up to 35m deep, occupying a glacial fjord on the northeastern slopes of Mt Cayambe. The lake is oligotrophic, with very acidic and strongly stratified waters; it is fed by several streams from melting glaciers. The water level remains fairly constant.
Principal vegetation: There are some patches of *Myriophyllum* and *Potamogeton* in shallow areas at the north end of the lake. Eighty-two species of phytoplankton have been recorded, with the Chrysophyta *Dinobrion sertularia* predominating.
Land tenure: State owned.
Protection: Within the Cayambe-Coca Ecological Reserve (403,103 ha) established in 1970 and increased to its present size in 1979.
Land use: No information.
Waterfowl: No information.
Other fauna: The planktonic fauna has been described in some detail by Steinitz-Kannan *et al* (1983). The lake is of great limnological interest as a true fjord lake with very acidic waters and marked stratification.
Threats: No information.
Research and conservation: The lake has been the subject of detailed limnological investigations.
References: Steinitz-Kannan *et al* (1982 & 1983); Figueroa (1983).
Source: See references.
Criteria for inclusion: 2b & 3a.

The upper Rio Blanco (9)

Location: 0°02'S, 78°48'W; 40 km northwest of Quito, Pichincha Province.
Area: Unknown.
Altitude: c.2,100m.
Province and type: 8.33.12; 10.
Site description: Fast-flowing rivers and streams in the upper Rio Blanco drainage on the Pacific slope of the Andes west of the town of Mindo. One of the few areas on the Pacific slope of Ecuador with relatively undisturbed subtropical forest, and clear water rivers and streams.

Principal vegetation: In humid subtropical montane forest.
Land tenure: Mainly state owned, but with private holdings around the town of Mindo.
Protection: None at present.
Land use: Some forest clearance and agriculture.
Waterfowl: Few true waterfowl occur, but these include *Tigrisoma fasciatum, Merganetta armata* and the very local *Aramides wolfi.*
Other fauna: The area is very rich both faunistically and floristically. Over 300 bird species have been recorded many of which, although not typical waterfowl, are closely associated with the rivers and streams. The Spectacled Bear *Tremarctos ornatus* is reported to be relatively common.
Threats: There is a plan to construct a road between Mindo and Ulloa which would open up this remote area to further forest clearance and colonization.
Research and conservation: A proposal exists to create a protected area in the region, with the headquarters in Mindo, but apparently there is some political opposition to this.
Source: Fernando Ortiz, Clemencia Vela and Paul Greenfield.
Criteria for inclusion: 2a & 3a.

Lakes and bogs at Papallacta Pass (10)

Location: 0°18'S, 78°10'W; in the western part of the Cayambe-Coca Ecological Reserve, Napo Province.
Area: c.700 ha.
Altitude: 4,100m.
Province and type: 8.33.12; 12 & 19.
Site description: Numerous small freshwater lakes, marshes and Andean bogs near Papallacta Pass. Many of the lakes and bogs are difficult of access, and few have been investigated.
Principal vegetation: In the paramo zone, with some elfin forest of *Polylepis* sp.
Land tenure: State owned.
Protection: Within the Cayambe-Coca Ecological Reserve (403,103 ha) established in 1970 and increased to its present size in 1979.
Land use: A little cattle grazing, burning of grassland and hunting.
Waterfowl: A variety of high Andean waterfowl have been recorded, including *Anas flavirostris, Gallinago nobilis, G. stricklandii jamesoni* and *Larus serranus.* It is possible that the rare *Theristicus (c) branickii* still occurs in the area.
Other fauna: No information.
Threats: None known.
Research and conservation: A management plan has been prepared for the Ecological Reserve, but the wetlands remain very poorly known.
References: Paucar & Reinoso (1978); IUCN (1982); Figueroa (1983).
Source: Fernando Ortiz, Clemencia Vela and Paul Greenfield.
Criteria for inclusion: 3a.

Lago Papallacta (11)

Location: 0°22'S, 78°10'W; 25 km west of Baeza, Napo Province.
Area: 38 ha.
Altitude: 3,920m.
Province and type: 8.33.12; 10 & 12.
Site description: A small permanent freshwater lake, up to 5.5m deep, formed by a landslide across the Rio Papallacta. The Rio Papallacta and other streams feeding the lake are still relatively unspoiled.

Principal vegetation: Fringing marshes of *Scirpus californicus* and *Junus* sp . The predominant phytoplankton is the diatom *Synedra ulna chaseana.* In the paramo zone, with some damp meadows and patches of cloud forest near the lake.
Land tenure: No information.
Protection: None, but close to the boundary of the Cayambe-Coca Ecological Reserve.
Land use: Some farming, quarrying of rock, hunting and fishing.
Waterfowl: A variety of high Andean waterfowl occur in small numbers, including *Anas flavirostris* and *Gallinago nobilis. Merganetta armata* still nests along the Rio Papallacta.
Other fauna: No information.
Threats: Excessive disturbance from human activities, particularly hunting.
Research and conservation: Limnological studies have been carried out by Steinitz-Kannan *et al.*
References: Steinitz-Kannan *et al* (1983).
Source: Fernando Ortiz, Clemencia Vela and Paul Greenfield.
Criteria for inclusion: 3a.

Laguna La Mica (12)

Location: 0°33'S, 78°12'W; on the south slope of Cerro Antisana, ESE of Quito, Napo Province.
Area: Unknown.
Altitude: 4,100m.
Province and type: 8.33.12; 12.
Site description: A permanent freshwater lake in the high Andes, deriving its water from snow melt on Antisana.
Principal vegetation: In the paramo zone.
Land tenure: Privately owned.
Protection: No legal protection, but the land owners restrict access.
Land use: Some hunting and fishing.
Waterfowl: A variety of high Andean species have been recorded including *Podiceps occipitalis, Theristicus (c) branickii, Anas flavirostris, A. georgica, Vanellus resplendens, Attagis gayi* and *Larus serranus.*
Other fauna: No information.
Threats: None known.
Source: Fernando Ortiz, Clemencia Vela and Paul Greenfield.
Criteria for inclusion: 3a.

Limpiapungo Lake and Paramo (13)

Location: 0°40'S, 78°30'W; in Cotopaxi National Park, Cotopaxi Province.
Area: Area of wetlands unknown; Limpiapungo Lake 1 ha.
Altitude: Lake at 3,800m; National Park 3,300-6,000m.
Province and type: 8.33.12; 12 & 19.
Site description: Limpiapungo Lake is a permanent freshwater lake, up to 65 cm deep, in a basin at the intersection of valley systems below the snow-capped peak of Cotopaxi Volcano. There are glacial features in the vicinity, but the lake itself is not of glacial origin. There are extensive areas of bog and wet grassland in the surrounding paramo.
Principal vegetation: There is a benthic mass of *Phormidium* sp in the lake. The typical paramo vegetation includes *Hyperium laricifolium, Brachyotum lepidifolium, Chuquiragua lancifolia, Polylepis incana, Buddelia incana, Oreopanax argentata* and some Cyperaceae.
Land tenure: About 50% state owned and 50% privately owned.
Protection: Within the Cotopaxi National Park (33,393 ha) established in 1975.
Land use: Tourism in the National Park.

Waterfowl: A variety of high Andean waterfowl occur, including *Theristicus (c) branikii, Anas flavirostris, A. georgica, Fulica americana/ardesiaca, Vanellus resplendens, Gallinago stricklandii jamesoni, Attagis gayi* and *Larus serranus*. *Anas discors* and five species of Nearctic shorebirds have been recorded in small numbers.
Other fauna: No information.
Threats: Some minor disturbance from tourism. The wardening in the National Park is inadequate and there have been reports of illegal hunting.
Research and conservation: Limnological studies have been carried out by Steinitz-Kannan *et al.*
References: Colinvaux & Steinitz (1980); IUCN (1982); Steinitz-Kannan *et al* (1983)
Source: Fernando Ortiz, Clemencia Vela and Paul Greenfield.
Criteria for inclusion: 3a.

Laguna de Colta (14)

Location: 1°45'S, 78°44'W; 15 km southwest of Riobamba, Chimborazo Province.
Area: 240 ha.
Altitude: 3,420m.
Province and type: 8.33.12; 12.
Site description: A permanent freshwater Andean lake, up to 3.5m deep, created by a lava flow some 2,000 years ago. The lake is fed by several seasonal streams; it shows some annual fluctuations in water level according to local rainfall, and has been decreasing in size for several decades.
Principal vegetation: Most of the lake is surrounded by dense stands of *Scirpus californicus*.
Land tenure: State owned.
Protection: None.
Land use: The local Indians utilize the reeds for weaving handicrafts.
Waterfowl: A variety of both highland and lowland species have been recorded, including nine species of Nearctic shorebirds, and up to 200 *Anas discors*.
Other fauna: No information.
Threats: None known, other than a natural decrease in the water level.
Research and conservation: Some limnological studies have been conducted.
References: Chapman (1926); Steinitz-Kannan *et al* (1983)
Source: Fernando Ortiz, Clemencia Vela and Paul Greenfield.
Criteria for inclusion: 3a.

Lakes in the Cuenca area (15)

Location: 2°50'S, 79°15'W; in the southern Andes of Ecuador, 30 km west of Cuenca, Azuay Province.
Area: Unknown.
Altitude: c.4,000m.
Province and type: 8.37.12; 12.
Site description: Over 95 small glacial lakes, up to 100 ha in extent, and numerous ponds in the high Andes of southern Ecuador. Two small lakes in the Andes to the east of Cuenca, Laguna de Kingora near Sigsig, and Lago de Culebrillas on Cerro Yanaurco, are presumably similar.
Principal vegetation: In the paramo zone.
Land tenure: State owned.
Protection: Partly within the Cajas National Recreation Area (27,323 ha) established in 1977 and redefined in 1979. The Recreation Area includes some 250 small lakes and ponds.

Land use: Recreation, particularly trout fishing.
Waterfowl: A variety of high Andean waterfowl were recorded at Laguna de Kingora and Lago de Culebrillas at the end of the nineteenth century, but no information seems to be available on any of the lakes in this area since then.
Other fauna: No information.
Threats: The demands of Cuenca city for water pose a potential threat to many of the lakes.
Research and conservation: The lakes are of considerable limnological interest, and the entire area has great potential for outdoor recreation and conservation education.
References: Figueroa (1983); Ortiz (1983).
Source: Miriam Steinitz-Kannan.
Criteria for inclusion: 3a.

The lower Rio Santiago and Rio Cayapas (16)

Location: 1°12'-1°25'N, 78°51'-79°02'W; near San Lorenzo and Borbon, Esmeraldas Province.
Area: 65,000 ha.
Altitude: 0-20m.
Province and type: 8.3.1; 02, 08, 09 & 11.
Site description: The estuarine system of the Santiago and Cayapas Rivers with extensive mangrove swamps; and meandering rivers, riverine marshes, and associated oxbow lakes and marshes in the nearby lowlands. The extent of the riverine marshes varies considerably according to rainfall.
Principal vegetation: Mangrove swamps at the river mouths. In relatively undisturbed humid tropical forest.
Land tenure: Partly state owned, and partly privately owned by indigenous groups.
Protection: None. The Rio Cayapas rises in the Cotacachi-Cayapas Ecological Reserve in the Western Andes.
Land use: Exploitation of timber, hunting, fishing (particularly for clams), and agriculture. There are extensive plantations of bananas, papayas and other tropical fruits around Borbon.
Waterfowl: The waterfowl of the region are very poorly known, but most if not all of the species typical of the western humid tropical zone of Ecuador might be expected to occur. Species observed during a brief survey of the mangrove areas in March 1980 included *Pelecanus occidentalis*, a variety of Ardeidae, several Nearctic shorebirds, *Larus atricilla, L. pipixcan* and *Chlidonias nigra.* Other species known to occur include *Agamia agami, Heliornis fulica* and *Aramides wolfi.*
Other fauna: Over 10 Ospreys *Pandion haliaetus* were observed in March 1980. The sea turtle *Chelonia mydas* occurs on nearby beaches.
Threats: Forest clearance and uncontrolled hunting. The larger mammals have been almost exterminated in the area.
Research and conservation: Undoubtedly still a rich area for wetland species, but very poorly known. A thorough survey is clearly called for.
References: Chapman (1926).
Source: Fernando Ortiz, Clemencia Vela and Paul Greenfield.
Criteria for inclusion: 0.

The lower Rio Chone and Bahia de Caraquez (17)

Location: 0°40'S, 80°15'W; between the towns of Chone and Bahia de Caraquez, Manabi Province.
Area: 5,000 ha.
Altitude: 0-20m.
Province and type: 8.3.1; 02, 06, 07, 08, 09, 11 & 18.
Site description: A slow-flowing river (Rio Chone) with associated oxbow lakes, marshes and swamp forest; and its estuary in Bahia de Caraquez, with tidal mudflats, mangrove swamps, and brackish coastal lagoons and marshes.

Principal vegetation: Extensive mangrove swamps and swamp forest. In a region of humid tropical to semi-arid tropical forest.
Land tenure: Privately owned.
Protection: None.
Land use: No information.
Waterfowl: A variety of waterfowl typical of the western lowlands of Ecuador were observed by Chapman in the 1920s, but no information has become available since then.
Other fauna: No information.
Threats: Wetland habitat is being lost to shrimp farming; there is contamination with pesticides used in the control of malaria; and offshore drilling for oil poses a potential threat of pollution.
Research and conservation: The area is particularly important for its rich mangrove and estuarine communities. Some work has recently been done on the mangroves by the Escuela Superior Politecnica del Litoral, and a proposal was made by the Universidad Catolica in Quito and the Canadian Wildlife Service to carry out a wetland evaluation project in the region in 1983/84.
References: Chapman (1926).
Source: Fernando Ortiz, Clemencia Vela, Paul Greenfield and Nancy Hilgert.
Criteria for inclusion: 2b, 2c & 3a.

Ecuasal Lagoons (18)

Location: 2°17'S, 80°55'W; 8 km southeast of Salinas, Guayas Province.
Area: Several hundred ha.
Altitude: 0m.
Province and type: 8.19.4; 07.
Site description: A complex of artificial saline lagoons with some associated saline marshes, near the sea coast.
Principal vegetation: No information.
Land tenure: Privately owned.
Protection: None, but access to the area is partly restricted by the owners.
Land use: Commercial extraction of salt.
Waterfowl: An important area for a wide variety of shorebirds and Laridae, including seventeen Nearctic migrants. The commonest Nearctic shorebirds are *Charadrius semipalmatus*, *Tringa melanoleuca*, *T. flavipes*, *Catoptrophorus semipalmatus*, *Arenaria interpres*, *Limnodromus griseus*, *Calidris alba*, *C. pusilla*, *C. minutilla* and *Steganopus tricolor* (up to 1,000). Thirty pairs of *Larus cirrocephalus* were found breeding in July 1978, the first breeding record for Ecuador and the northernmost on the Pacific coast of South America. *Himantopus himantopus* is common, and *Phoenicopterus chilensis* has occurred as an occasional visitor.
Other fauna: *Pandion haliaetus* and *Falco peregrinus* occur as non-breeding visitors.
Threats: Hunting may be a problem.
Research and conservation: Several avifaunal surveys have been conducted in the area in recent years, particularly by Greenfield and Ridgely.
References: Marchant (1958); Ridgely & Wilcove (1979); Ridgely (1980).
Source: Fernando Ortiz, Clemencia Vela, Paul Greenfield and Nancy Hilgert.
Criteria for inclusion: 3a.

The Santa Elena Peninsula and Gulf of Guayaquil (19)

Location: 1°20'-3°00'S, 79°30'-81°00'W; Guayas Province.
Area: c.650,000 ha.
Altitude: 0-30m.
Province and type: 8.19.4; 02, 03, 06, 07, 08, 09, 11, 12, 16, 17 & 18.
Site description: A vast complex of slow-flowing rivers and associated marshes, freshwater lakes, swamp forest, seasonally flooded grassland, rice growing areas, and seasonally flooded

arable land at the head of the Gulf of Guayaquil; and the estuarine systems of the Gulf with low-lying offshore islands, extensive intertidal sand and mud-flats, and mangrove swamps. The wetland habitat has been greatly reduced in extent and much fragmented by land reclamation for agriculture and urban development, and large areas have been converted into rice paddies, salt ponds and shrimp farms. The most important sites within this region are described separately below.
Principal vegetation: Approximately 200,000 ha of mangrove swamps remain in the Gulf proper.
Land tenure: Formerly largely state owned, but now the greater part is privately owned.
Protection: Largely unprotected. There is a mangrove reserve of 35,042 ha (the Manglares-Churute Ecological Reserve, established in 1979) and a faunal and floral reserve at Cerro Churute, but these are poorly enforced.
Land use: Urban development at Guayaquil and many smaller towns in the region; agriculture, particularly rice growing; shrimp farming; hunting; and fishing. There are now some 50,000 ha of shrimp farms in the Gulf of Guayaquil; about half replaced mangrove swamps and the remainder were sited in "salitrales", low-lying salty areas with little vegetation.
Waterfowl: An extremely important area for waterfowl of a wide variety of species, and probably one of the most important wintering areas for Nearctic shorebirds in South America. Over eighty species are known or thought to occur including many Ardeidae, Anatidae, shorebirds and Laridae, but no census data are available.
Other fauna: *Crocodylus acutus* still occurs in the Babahoyo area, but it is now practically extinct.
Threats: The destruction of the wetland habitat continues at a rapid rate as land is reclaimed for urban growth and agriculture. About one eighth of the mangroves have already been destroyed for shrimp farms, and this continues. There is a considerable amount of hunting, particularly of Anatidae and of birds thought to prey on shrimps.
Research and conservation: Several avifaunal surveys have been conducted in the region, notably by Chapman (1926), Marchant (1956) and Felix Man-ging of the University of Guayaquil, but remarkably little work seems to have been done on other wildlife.
References: Chapman (1926); Marchant (1958 & 1960); Paynter & Taylor (1977); Ortiz (1983).
Source: Fernando Ortiz, Clemencia Vela, Paul Greenfield and Felix Man-ging.
Criteria for inclusion: 123.

Abras de Mantequilla (19a)

Location: 1°30'S, 79°38'W; 10 km east of Vinces, Guayas Province.
Area: c.10,000 ha.
Altitude: 30m.
Province and type: 8.19.4; 12, 16 & 17.
Site description: A complex of freshwater lakes and marshes, seasonally flooded savannas, and wet arable land; one of the few wetland areas still relatively undisturbed in the Santa Elena Peninsula.
Principal vegetation: No information.
Land tenure: Mainly state owned, with some private holdings.
Protection: None.
Land use: Some agriculture and hunting.
Waterfowl: Leveque recorded a variety of waterfowl typical of the lowlands of western Ecuador, but no work seems to have been done in the area since then.
Other fauna: No information.
Threats: None known.
Research and conservation: A remote area, difficult of access, and still relatively unspoiled. A thorough survey of the area should be carried out, and the possibility of establishing a reserve considered.
References: Leveque (1964).
Source: Fernando Ortiz, Clemencia Vela and Felix Man-ging.
Criteria for inclusion: 0.

Marshes between Santa Lucia and Daule (19b)

Location: 1°45'S, 79°56'W; near Santa Lucia, between Guayaquil and Balzar, Guayas Province.
Area: c.10,000 ha.
Altitude: 10m.
Province and type: 8.19.4; 13, 16 & 17.
Site description: A complex of freshwater ponds and marshes, seasonally flooded savanna, and wet arable land; on the east bank of the Rio Daule.
Principal vegetation: No information.
Land tenure: No information.
Protection: None.
Land use: Some agriculture.
Waterfowl: No recent information; 19th century ornithologists and Leveque recorded a variety of waterfowl typical of the region, including a number of Nearctic shorebirds.
Other fauna: No information.
Threats: No information.
References: Leveque (1964).
Source: Fernando Ortiz and Clemencia Vela.
Criteria for inclusion: 0.

The lower Rio Babahoyo and Rio Daule (19c)

Location: 2°05'S, 79°53'W; north of Guayaquil, Guayas Province.
Area: Unknown.
Altitude: 0-10m.
Province and type: 8.19.4; 09, 11 & 16.
Site description: Slow-flowing rivers, riverine marshes, associated oxbow lakes, and large areas of seasonally flooded savanna at the confluence of the Babahoyo and Daule Rivers. After the unusually heavy rains in 1983, much of the area became a large shallow lake.
Principal vegetation: No information.
Land tenure: The rivers are state owned; the adjacent lands are privately owned.
Protection: None.
Land use: Hunting, fishing, and some wood-cutting.
Waterfowl: 19th century ornithologists recorded a variety of waterfowl in the area, but there appears to be very little recent information. Byskov observed very large numbers of Ardeidae in October 1974, mainly *Egretta alba* and *E. thula*; and Steinitz-Kannan noted large concentrations of *Phalacrocorax olivaceus*, Ardeidae, Threskiornithidae and Anatidae in May 1984, when the area was still extensively flooded as a result of heavy rains in 1983.
Other fauna: Byskov recorded 400 *Rostrhamus sociabilis* in October 1974. The American Crocodile *Crocodylus acutus* still occurs in very small numbers near Babahoyo.
Threats: No information.
References: Byskov (1974).
Source: Fernando Ortiz, Clemencia Vela, Paul Greenfield, Miriam Steinitz-Kannan and Felix Man-ging.
Criteria for inclusion: 0.

Duran Marshes (19d)

Location: 2°00'S, 79°53'W; north of Guayaquil, Guayas Province.
Area: Unknown.
Altitude: 5m.
Province and type: 8.19.4; 13, 16 & 17.
Site description: A complex of freshwater ponds and marshes, seasonally flooded grassland, rice paddies and wet arable land between the Rio Babahoyo and Rio Daule.
Principal vegetation: No information.
Land tenure: No information.

Protection: None.
Land use: Agriculture, particularly rice-growing; and hunting.
Waterfowl: Species observed during brief surveys in recent years have included *Podiceps dominicus, Phalacrocorax olivaceus, Bubulcus ibis, Butorides striatus, Egretta thula, E. alba, Dendrocygna bicolor, D. autumnalis, Anas bahamensis, A. discors, Aramus guarauna, Laterallus albigularis, Gallinula chloropus, Porphyrula martinica, Jacana jacana, Himantopus himantopus* and four species of Nearctic shorebirds, *Tringa solitaria, T. melanoleuca, T. flavipes* and *Actitis macularia*. *Anhima cornuta* was last seen in the area by R. Ridgely in 1976.
Other fauna: No information.
Threats: Excessive hunting and general disturbance from human activities.
Source: Fernando Ortiz, Clemencia Vela, Paul Greenfield and Felix Man-ging.
Criteria for inclusion: 0.

Estuary of the Rio Guayas (19e)

Location: 2°25'S, 79°55'W; from Guayaquil south for 50 km, Guayas Province.
Area: c.150,000 ha.
Altitude: 0m.
Province and type: 8.19.4; 02, 06, 07, 08 & 16.
Site description: An extensive estuarine system of several large rivers, with intertidal sand and mud-flats, saline marshes, mangrove swamps and numerous salt water channels and inlets. The surrounding savanna is extensively inundated during the rainy season.
Principal vegetation: The dominant mangroves are *Rhizophora mangle, Laguncularia racemosa* and *Avicennia germinans*.
Land tenure: A mixture of state and private ownership. 98% of the mangrove reserve is state owned.
Protection: Part of the mangroves are included within the Manglares-Churute Ecological Reserve (35,042 ha) established in 1979, but there are insufficient funds for adequate protection. Other areas are unprotected.
Land use: A great part of the region is now under urban development, with large industrial and housing developments spreading south from Guayaquil. Elsewhere, activities include fishing, shrimp farming, cutting of mangroves, and dumping of waste. There is a considerable amount of shipping in the estuary.
Waterfowl: The estuary is known to be of very great importance both for resident species and for migratory shorebirds, but no adequate surveys have as yet been undertaken.
Other fauna: No information.
Threats: Areas around Guayaquil are being colonized and developed, and the wetlands are rapidly disappearing. Mangroves are being destroyed for shrimp ponds; there is serious pollution from shipping and industry; there is contamination with pesticides used in the control of malaria; some areas are being used as rubbish dumps; and there is considerable disturbance from hunting.
Research and conservation: Despite the obvious importance of this estuarine system, little work seems to have been conducted on its animal and plant communities. Brosset, Leveque and Mills made some ornithological observations in the 1960s, and in recent years some investigations have been made by the University of Guayaquil and Greenfield, but the entire area clearly merits an in depth study.
References: Leveque (1964); Brosset (1964); Mills (1967); Paynter & Taylor (1977); Leck (1980); IUCN (1982).
Source: Fernando Ortiz, Clemencia Vela, Paul Greenfield and Felix Man-ging.
Criteria for inclusion: 2b, 2c & 3a.

Isla Puna (19f)

Location: 2°50'S, 80°05'W; 70 km SSW of Guayaquil, Guayas Province.
Area: c.100,000 ha.

Altitude: 0m.
Province and type: 8.19.4; 03, 06 & 08.
Site description: A large low-lying island in the estuary of the Rio Guayas, with fringing mangrove swamps and extensive areas of intertidal sand and mud-flats.
Principal vegetation: No information.
Land tenure: No information.
Protection: None.
Land use: No information.
Waterfowl: Almost unknown; a few species were recorded by Leveque including *Eudocimus albus*, *Ajaia ajaja* and *Aramides axillaris*, but the area must surely be of great importance for migratory shorebirds and Laridae.
Other fauna: No information.
Threats: Concessions have recently been granted for the destruction of mangroves.
Research and conservation: Presumably a very important area, but as yet almost unknown.
References: Leveque (1964).
Source: Fernando Ortiz, Clemencia Vela, Paul Greenfield and Felix Man-ging.
Criteria for inclusion: 0.

Wetlands in the Santa Rosa area (20)

Location: 3°27'S, 79°58'W; 20 km south of Machala, El Oro Province.
Area: Unknown.
Altitude: 0-10m.
Province and type: 8.19.4; 03, 05, 06 & 12.
Site description: A series of small freshwater lakes and marshes on the arid coastal plain of southwestern Ecuador, adjacent sandy beaches, and two offshore islands, La Plata and Salango.
Principal vegetation: No information.
Land tenure: No information.
Protection: Within the Machalilla National Park.
Land use: No information.
Waterfowl: Very poorly known. The area was visited briefly by Greenfield in August 1980 and a wide variety of species was recorded including *Mycteria americana*, *Eudocimus albus*, *Dendrocygna bicolor*, *D. autumnalis*, *Anas bahamensis*, *Laterallus albigularis* and *Gelochelidon nilotica*. *Burhinus superciliaris* was found in the surrounding semi-desert.
Other fauna: There are important sea turtle nesting beaches on the islands.
Threats: There is a possibility that an oil terminal will be constructed on the islands.
Source: Fernando Ortiz, Clemencia Vela, Paul Greenfield and Nancy Hilgert.
Criteria for inclusion: 0.

Saline ponds of the Galapagos Islands (21)

Location: 0°10'N-1°00'S; 89°20'-91°40'W; in the Galapagos Islands, 1,000 km west of the Ecuadorean coast.
Area: Area of wetlands unknown.
Altitude: 0m.
Province and type: 8.44.13; 07 & 08.
Site description: A number of small saline ponds, up to 1m deep, behind sea beaches, with or without stands of mangroves; in the arid shrub and cactus zone on all the main islands in the archipelago. The ponds are flooded at the highest tides, and then gradually fall in level and increase in salinity as a result of seepage and evaporation. The principal ponds are as follows: Las Salinas, Puerto Villamil, Puerto de Jeli, Tercera Playa, Cuarta Playa, Quinta Playa and Puerto Fragata on Isabela; ponds on Rabida; El Sarten on Santiago; ponds on Baln Bridge; Punta Rocafuerte, Bahia Tortuga and Bahia Borrero on Santa Cruz; and Punta Cormorant and La Montura on Floreana.

Principal vegetation: Mangrove swamps with *Rhizophora mangle, Avicennia germinans, Conocarpus erectus* and *Laguncularia racemosa*; surrounding arid scrub and woodland with *Prosopis juliflora, Parkinsonia aculeata, Bursera graveolans, Ipomoea pescaprae* and *Opuntia echios inermis*.
Land tenure: 97% of the land in the archipelago is state owned, the rest is private.
Protection: Within the Galapagos National Park first established in 1936; Figueroa (1983) gives the area of the Park as 679,000 ha.
Land use: Tourism in the National Park.
Waterfowl: Over 50 species of waterfowl have been recorded, including 29 species of Nearctic shorebirds, but many of these have occurred only as rare vagrants. Resident breeding species include the following endemic subspecies: *Pelecanus occidentalis urinator, Nyctanassa violaceus pauper, Butorides striatus sundevalli* (possibly a distinct species), *Ardea herodias cognata, Anas bahamensis galapagensis* and *Haematopus palliatus galapagensis* (total population only about 100 pairs). Other breeding species include *Egretta alba, Phoenicopterus ruber* (total population of 400-500 individuals confined to the salt ponds), *Gallinula chloropus* and *Himantopus himantopus*. Of the many Nearctic shorebirds which have been recorded, only *Charadrius semipalmatus, Numenius phaeopus, Heteroscelus incanus, Arenaria interpres, Calidris alba* and *Lobipes lobatus* occur in significant numbers. *H. incanus* occurs in large numbers on rocky shores, and it is clear that the Galapagos Islands constitute a major wintering area for this species. *Anas discors* is a regular winter visitor in small numbers.
Other fauna: The ponds support an abundant invertebrate fauna, but lack mammals, reptiles and amphibians.
Threats: Urban areas continue to expand, and there are increasing pressures on the National Park. Ponds near to human settlements, e.g. the ponds at Puerto Villamil, are particularly subject to disturbance. Tourism may cause disturbance at some ponds; the Master Plan for the National Park initially called for a maximum of 12,000 visitors per year, but this was increased to 20,000 in 1981. A constant danger is the deliberate or accidental introduction of new species which, through direct predation, competition, hybridization or the introduction of diseases, may threaten the endemic fauna.
Research and conservation: A large amount of research has been carried out in the islands, and the small resident flamingo population has received a considerable amount of attention. The avifauna has been described in some detail by Harris. A Master Plan for the National Park has been produced, and if properly implemented, should secure the future of the rich endemic flora and fauna of the archipelago.
References: Leveque *et al* (1966); Colinvaux (1968); Howmiller (1969); Leleup & Leleup (1970); Harris (1973 & 1974); Kramer (1973); Steinitz-Kannan (1979); Moore (1980); Moore & Toui de Roy (1980); Castro (1981); IUCN (1982); de Groot (1983); Figueroa (1983).
Source: Fernando Ortiz and Clemencia Vela.
Criteria for inclusion: 123.

Laguna El Junco (22)

Location: 0°55'S, 89°30'W; on San Cristobal Island in the Galapagos Islands.
Area: 5.7 ha.
Altitude: 700m.
Province and type: 8.44.13; 12.
Site description: A small permanent freshwater lake, 6m deep, with paramo-like vegetation in the humid highlands of San Cristobal. A lake of great antiquity, and the only significant freshwater body in the Galapagos Islands.
Principal vegetation: The aquatic vegetation includes the endemic species *Micobia robinsoniana* and *Cyathea weatherbyana*, and *Azolla microphylla, Ludwigia peploides, Eleocharis mutata* and *Polygonum* sp.
Land tenure: State owned.
Protection: Within the Galapagos National Park (679,000 ha) established in 1936.
Land use: Tourism.
Waterfowl: *Anas bahamensis galapagensis* and *Gallinula chloropus* occur.
Other fauna: No information.

Threats: The lake is accessible by road, and visited by many tourists. There are some domestic livestock in the area, and the danger of introduction of exotic plants and animals is high.
Research and conservation: Limnological studies have been conducted at the lake by Steinitz-Kannan *et al.*
References: Colinvaux & Steinitz (1980); IUCN (1982); Steinitz-Kannan *et al* (1983).
Source: Fernando Ortiz, Clemencia Vela and Carlos Valle.
Criteria for inclusion: 2b & 3b.

FALKLAND ISLANDS

INTRODUCTION

by **Andrew F. G. Douse**

The Falkland Islands are located about 550 km east of the tip of South America between latitudes 51° and 52° South, and longitudes 58° and 61° West. The population of about 2,500 depends almost entirely on sheep farming for wool. Ranches are large and under thirty landowners manage the total of about 12,170km^2. The islands are gently sloping with hills up to 700m, but the southern portion of East Falkland is low and level, rarely exceeding 90m.

The climate is cold temperate with an annual mean temperature of 5.6°C and extremes from about -8 to 25. Annual rainfall varies from about 635 mm in the east to less than 405 mm on West Falkland. The dominant vegetation is the grass *Cortaderia pilosa* and the low shrub *Empetrum rubrum.* Tussock grass *Poa flabellata* is now confined to small islands and other areas where sheep cannot graze.

The wetland habitats have been described in some detail by Weller (1973). Except for a very small proportion of the total land area, the soil is blanket peat of variable thickness, and thus under the definition of wetlands in the Ramsar Convention, almost the whole of the Falklands can be termed wetland. However estuaries are very small and there are no large lakes or extensive marshes. Instead there is a very large number of shallow freshwater ponds, up to several hundred hectares in extent, marshes and streams scattered throughout the islands. The ponds are acid (pH mainly in the range 4.0 to 5.3) with sand or cley bottoms. Most ponds have beds of *Myriophyllum* and the alga *Nitella*, and some have marginal stands of the emergent spikerush *Eleocharis melanostachys.* Sea shores are mainly rocky; on exposed shores water worn strata have formed shelves exposed at low tide and with abundant marine algae. Sandy beaches fringe many bays, and there are some small coastal sand-bottomed ponds with *Ruppia.*

The avifauna of the islands has been documented by Woods (1975), and more recently Standring (1982) has reviewed the status of the waterfowl. Amongst the numerous breeding waterfowl, there are endemic subspecies of the grebe *Rollandia rolland* and the night heron *Nycticorax nycticorax*, and an endemic species of steamer duck, *Tachyeres brachypterus.* Also of particular note is the large population of the Ruddy-headed Goose *Chloephaga rubidiceps*, a species now facing extinction in the remainder of its range in continental South America. Few Nearctic shorebirds reach the Falkland Islands, but one species, *Calidris fuscicollis*, does so in large numbers, while *Calidris alba* is not uncommon.

Standring (1982) also notes that there are two endemic species of freshwater fishes, *Aplochiton zebra* and *Galaxis maculatus.* Both have suffered marked declines in recent years and have been supplanted in many waters as a result of the introduction of the Brown Trout *Salmo trutta.*

Institutional Base for Wetland Conservation and Research

The Agricultural Research Centre, Port Stanley, carries out research into sheep husbandry, grassland improvement and veterinary matters. The research into the Upland Goose *Chloephaga picta* is undertaken on behalf of this organization. It is funded and run by the Overseas Development Administration in the United Kingdom.

The Falkland Islands Trust, Port Stanley, is the only locally based conservation organization. It has responsibility for wildlife and objects of historical interest.

The Falkland Islands Foundation, c/o World Wildlife Fund - UK, is a private foundation based in the United Kingdom and dedicated to nature conservation in the Falkland Islands. The Foundation owns or leases sixteen small tussock islands in the archipelago, and intends to acquire other important wildlife areas, particularly those under threat, as and when they become available. The Foundation also provides both the military and the schools with educational material on Falklands wildlife. The work of the Foundation has been described by Lyster (1984).

Progress in Wetland Conservation and Research

The ordinance governing the protection of wild birds and other animals dates from 1964, and is due for revision. However, such revision is not to the author's knowledge in preparation, nor is it likely to be for some time. In particular, no action has been taken by the Government of the United Kingdom or the Falkland Islands Government to implement the principles of the Ramsar Convention. Standring (1982) has made a variety of recommendations with respect to the application of the Ramsar Convention in the Falkland Islands, and it is to be hoped that these will be acted upon in the future.

The legislation for the creation of reserves is included in Standring (1982) and a detailed critique is also given. Since most land is privately owned, there is little that the Falkland Islands Government can do, other than to enter into some voluntary agreement with landowners. However, in the last four years, the Government has purchased three farms from their respective owners and then resold them to individuals after subdivision into smaller "family units". The last farm to be purchased was Packe's Port Howard which incorporated the important waterfowl site Hawk's Nest Ponds. The Government agreed with the purchasing landowner that the ponds should be preserved in their natural condition and the Falkland Islands Trust has undertaken to carry out a systematic survey of the site and to provide advice for its conservation and development as a tourist attraction. Future land sales will however be direct, and it will therefore be difficult for the Government to obtain such agreements.

The following reserves and sanctuaries have been established to date:

- Reserves
  - Kidney Island and Cochon Island
  - Flat Jason Island
  - Bird Island
  - Crown Jason Island
  - Sea Dog Island and Arch Island
- Sanctuaries
  - The Twins, off Carcass Island
  - Low Island
  - Beauchene Island
  - Elephant Jason Island
  - Middle Island
  - Volunteer and Cow Bay
  - Cape Dolphin
  - Bleaker Island
  - Stanley Common and Cape Pembroke

In the case of development projects, such as the new airport at Mount Pleasant, the Falkland Islands Government can either obtain the advice of local scientists and naturalists, or employ a scientist to carry out an environmental impact assessment. The latter course was taken for the Mount Pleasant airport; Dr John Miles of the Institute of Terrestrial Ecology in the United Kingdom was contracted to make an impact assessment. The report (Miles, 1984) includes information relevant to at least two areas of importance to waterfowl: Bertha's Beach and Swan Inlet. The Government does not have its own conservation/environment officer despite the requirement for one pointed out by Lord Shackleton in his 1982 report.

A programme of research is currently being undertaken into the ecology of the Upland Goose *Chloephaga picta* and its role as an agricultural pest. The research has been in progress since 1974 and is due to continue for at least another two years. The main theme at present is the effect of the geese on introduced reseeded pasture. Information is also being collected on habitat dispersion and it is hoped to obtain an accurate estimate of the population size. A banding programme was carried out in 1977-1979 involving the use of colour rings, metal rings and neck collars. Some banding is still in progress but at a much reduced level. Recent publications on this research include Harradine (1982), Summers (1979, 1983a, 1983b, in press-a & in press-b), Summers & Dunnet (1984) and Summers & Grieve (1982).

Some work has been conducted on *Chloephaga rubidiceps* (Summers *et al*, in prep.), and there is a proposal to initiate a more detailed research programme on the species, but this has not as yet been confirmed.

Recently, Dr P. Humphrey of the University of Kansas has undertaken field work on the endemic Falkand Islands Steamer Duck *Tachyeres brachypterus* as part of his research into steamer ducks in general. His research also touches on the status of the Falkland Islands Flying Steamer Duck *T. patachonicus.*

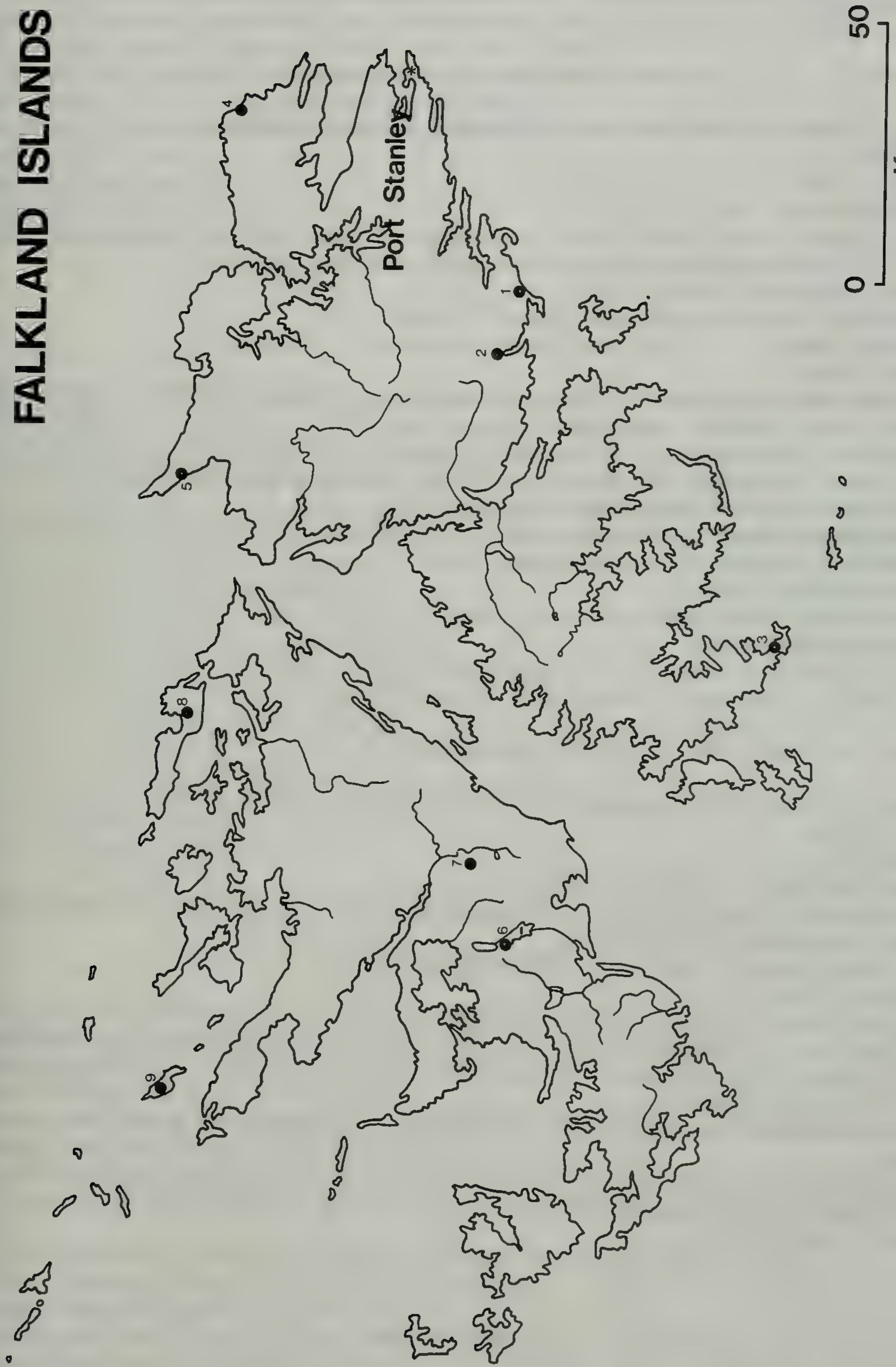
The Falkland Islands Foundation has recently initiated a small-scale breeding bird survey by distributing survey forms to interested islanders and visitors. The results of this survey will be collated by Robin Woods and published in the Foundation's newsletter. A more detailed survey will be conducted when adequate funds and logistic support become available.

Major Threats to Wetlands and Waterfowl

In general, industrial development, pollution and hunting are not considered to be sources of pressure on wetland habitat or their waterfowl. The one possible exception to this is the new Mount Pleasant airport. The potential environmental problems associated with this development have been discussed by Miles (1984).

The major industry of the Falkland Islands is sheep farming, and consequently any development of the farming sector may put pressure on some waterfowl habitat. At present, most sheep farms in the Falklands are operated on an extensive scale in which sheep are generally set stocked on natural pasture. However the present trend is towards subdivision and greater intensification. One of the main priorities of the Agricultural Research Centre is to investigate the potential for reseeding areas of natural pasture to provide high quality feed at particular times of the year. It is unlikely that more than about 5-10% of the total land surface would ever be reseeded and thus it is unlikely that the bird communities of the natural pastures would be seriously threatened.

In developed countries, agricultural drainage schemes are a frequent source of pressure on wetland ecosystems. In the Falklands, such drainage schemes have been carried out on a very limited scale in the past, and are unlikely to become more widespread in the future. The areas involved would be small and unlikely to repay the investment in machinery and labour costs that would have to be met.


FALKLAND ISLANDS
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WETLANDS

Site descriptions based on data sheets provided by Andrew F. G. Douse.

Bertha's Beach and associated ponds (1)

Location: 51°50'S, 58°20'W; southwest of Fitzroy Settlement, East Falkland.
Area: 2,000 ha.
Altitude: 5-10m.
Province and type: 7.4.9; 05, 12 & 13.
Site description: A sandy beach backed by coastal sand dunes and a series of permanent small shallow freshwater ponds and marshes, occasionally icing over in winter.
Principal vegetation: *Eleocharis* sp.
Land tenure: Owned by the Falkland Islands Company.
Protection: None.
Land use: None.
Waterfowl: The ponds appear to support most if not all of the Falkland breeding species, including the relatively uncommon *Podiceps occipitalis*. There is a large population of *Charadrius falklandicus* in the area, and substantial numbers of *Calidris alba* occur on the beach. Large numbers of *Chloephaga picta* feed on the short grassland behind the dunes.
Other fauna: There are large penguin rookeries nearby.
Threats: There is some tourist pressure, and potential threats from the extraction of sand from the beach and disturbance from the nearby airport.
References: Miles (1984).
Source: Andrew F. G. Douse.
Criteria for inclusion: 3a.

Swan Inlet (2)

Location: 51°50'S, 58°35'W; southwest of Fitzroy Settlement, East Falkland.
Area: 1,000 ha.
Altitude: 0m.
Province and type: 7.4.9; 01, 02, 10 & 19.
Site description: A small coastal inlet and estuary of a fast-flowing river, with associated bogs.
Principal vegetation: No information.
Land tenure: Owned by the Falkland Islands Company.
Protection: None.
Land use: Fishing for sea trout.
Waterfowl: An important site for *Cygnus melancoryphus*; a large flock (up to 100 birds) is usually present. The birds moult there and many presumably breed.
Other fauna: No information.
Threats: Pollution from an oil jetty in nearby Mare Harbour, and some disturbance from tourism.
References: Standring (1982).
Source: Andrew F. G. Douse.
Criteria for inclusion: 1b.

Bull Point (3)

Location: 52°20'S, 59°20'W; south of North Arm Settlement, East Falkland.
Area: 4,000-5,000 ha.
Altitude: 0-40m.
Province and type: 7.4.9; 01, 04, 05, 12, 13 & 19.

Site description: Sea bay with rocky and sandy shores and coastal sand dunes backed by a complex of permanent freshwater ponds, marshes and peat bogs.
Principal vegetation: No details, but the area is noted for its rich native flora.
Land tenure: Owned by the Falkland Islands Company.
Protection: Protected by the North Arm Manager until 1984, but status now uncertain.
Land use: Until recently none, but possibly now to be grazed.
Waterfowl: Little studied, but the area is known to be an important site for Anatidae and shorebirds, with a diverse breeding waterfowl community.
Other fauna: Gentoo Penguins *Pygoscelis papua* and Elephant Seals *Mirounga leonina* occur.
Threats: None known.
References: Standring (1982).
Source: Andrew F. G. Douse.
Criteria for inclusion: 2b & 3a.

Cow Bay, Volunteer Point and Seal Bay (4)

Location: 51°23'S, 57°53'W; northeast of Johnsons Harbour, northeastern East Falkland.
Area: 10,000 ha.
Altitude: 0-50m.
Province and type: 7.4.9; 01, 04, 05, 06, 12, 13 & 19.
Site description: Sea bay with rocky and sandy shores and intertidal mudflats, backed by coastal sand dunes and extensive area of small freshwater lakes, ponds, marshes and peat bogs.
Principal vegetation: No information.
Land tenure: On a privately owned estate.
Protection: Volunteer Point and Cow Bay are included in a Nature Sanctuary.
Land use: Sheep grazing over most of the land.
Waterfowl: There is a very diverse breeding community of Anatidae in the marshes, and the beaches and mudflats are important for shorebirds, notably *Charadrius falklandicus, C. modestus* and "wintering" *Calidris fuscicollis.*
Other fauna: An important site for breeding sea-birds including three species of penguins. Elephant Seals *Mirounga leonina* also occur.
Threats: None known.
Source: Andrew F. G. Douse.
Criteria for inclusion: 2a & 3b.

Cape Dolphin (5)

Location: 51°20'S, 58°52'W; north of Port San Carlos, East Falkland.
Area: 15,000 ha.
Altitude: 0-80m.
Province and type: 7.4.9; 01, 04, 05, 12 & 13.
Site description: Sea bay with rocky and sandy beaches and coastal sand dunes backed by a complex of freshwater lakes, ponds and marshes.
Principal vegetation: Short grass communities with freshwater plant associations in the ponds. The Tussock Grass *Poa flabellata* and sandy grassland communities are of considerable botanic interest.
Land tenure: Owned by Port San Carlos Ltd. and the Falkland Islands Company.
Protection: There is a Nature Sanctuary at Cape Dolphin.
Land use: Sheep grazing over a part of the land.
Waterfowl: The area has an important breeding population of Anatidae and shorebirds. There are large populations of *Chloephaga picta* and *C. rubidiceps*, and a number of breeding pairs of *Tachyeres patachonicus*, a species very sparsely distributed in the islands.
Other fauna: The area has breeding colonies of sea-birds, and rookeries of Elephant Seals *Mirounga leonina* and Southern Sea-lions *Otaria flavescens.*
Threats: None known.

Research and conservation: The fencing of the Nature Sanctuary to exclude sheep grazing has resulted in a recovery of the Tussock Grass communities.
Source: Andrew F. G. Douse.
Criteria for inclusion: 2b & 3a.

Lake Sulivan (6)

Location: 51°53'S, 60°10'W; north of Fox Bay, West Falkland.
Area: 2,500 ha.
Altitude: 0-80m.
Province and type: 7.4.9; 12 & 19.
Site description: Shallow freshwater lake, maximum depth 3m, with associated ponds and marshes, and areas of peat bog. Large areas of the marshes dry out in summer.
Principal vegetation: *Eleocharis* sp and *Myriophyllum* sp.
Land tenure: Owned by the Falkland Islands Company.
Protection: None.
Land use: Sheep grazing.
Waterfowl: Most if not all of the Falkland Anatidae breed on Lake Sulivan or in the surrounding marshes, including *Cygnus melancoryphus*, *Anas sibilatrix* and *A. versicolor*. The lake also supports a breeding population of *Rollandia rolland* and a colony of *Sterna hirundinacea*.
Other fauna: Endemic fish species are known to be present.
Threats: None known.
Source: Andrew F. G. Douse.
Criteria for inclusion: 2b & 3a.

Hawk's Nest Ponds (7)

Location: 51°48'S, 59°57'W; NNE of Fox Bay, West Falkland.
Area: 500-1,000 ha.
Altitude: 50m.
Province and type: 7.4.9; 12, 13 & 19.
Site description: Two small permanent freshwater lakes, numerous small ponds, their associated marshes and surrounding peat bogs. The lakes and marshes ice over occasionally in winter.
Principal vegetation: Extensive areas of *Eleocharis* sp and *Myriophyllum* sp.
Land tenure: Privately owned.
Protection: The owners have agreed voluntarily to conserve the area.
Land use: Sheep grazing in the surrounding areas.
Waterfowl: The area has a particularly diverse breeding population of waterfowl and is one of the richest areas in the Islands. Of particular note is a colony of about 40 pairs of the endemic *Nycticorax nycticorax cyanocephalus*.
Other fauna: Both endemic fish species *Galaxius maculatus* and *Aplochiton zebra* are common.
Threats: None.
Research and conservation: The fauna and flora of the area remain largely unmodified by man. The owners have agreed to fence off the area from sheep grazing, and a systematic survey is to be carried out.
References: Standring (1982).
Source: Andrew F. G. Douse.
Criteria for inclusion: 123.

The eastern part of Pebble Island (8)

Location: 51°19'S, 59°30'W; off the north coast of West Falkland.
Area: 7,500 ha.

Altitude: 0-20m.
Province and type: 7.4.9; 01, 04, 05, 12 & 13.
Site description: Rocky and sandy sea coasts, coastal sand dunes, and a complex of small freshwater lakes, ponds and marshes. The lakes are shallow (under 4m deep) and several dry out almost completely during the summer.
Principal vegetation: Mainly *Myriophyllum* associations, with some *Eleocharis* sp.
Land tenure: Privately owned.
Protection: None.
Land use: Sheep and cattle grazing.
Waterfowl: There is a very large and diverse breeding community of Anatidae, particularly around Green and Ship Harbour Ponds. There are some 50 pairs of *Cygnus melancoryphus* and significant numbers of *Anas versicolor* and *Podiceps occipitalis.* Both *Chloephaga picta* and *C. rubidiceps* are common, and *Tachyeres patachonicus* probably breeds.
Other fauna: Substantial numbers of three species of penguin Spheniscidae breed in the area.
Threats: Probably none.
Research and conservation: It has been proposed that a study of the ecology of *Chloephaga rubidiceps* should be initiated on the island.
Source: Andrew F. G. Douse.
Criteria for inclusion: 1b, 2b & 3a.

Carcass Island (9)

Location: 51°16'S, 60°35'W; off the northwest coast of West Falkland.
Area: 200-300 ha of wetlands an on island of 1,800 ha.
Altitude: 0-200m.
Province and type: 7.4.9; 03, 04, 05, 13 & 19.
Site description: A small peat covered island with rocky and sandy beaches, sand dunes, and a number of small freshwater ponds and marshes.
Principal vegetation: Mainly short grassland, with some extensive areas of Tussock Grass *Poa flabellata.*
Land tenure: Privately owned.
Protection: The owners protect the area voluntarily.
Land use: Sheep farming. Tourism is being encouraged and is run successfully.
Waterfowl: There is a large population of waterfowl in a nearly natural state, including a colony of 50 pairs of *Nycticorax nycticorax cyanocephalus*, a particularly dense breeding population of *Chloephaga rubidiceps*, and a number of pairs of *Tachyeres patachonicus.*
Other fauna: The avifauna in general is very rich because of the absence of feral cats. The passerine populations are very dense, and the tameness of the birds is almost unique in the Falklands. There are large breeding colonies of penguins Spheniscidae and *Sterna hirundinacea*, and a colony of Elephant Seals *Mirounga leonina.*
Threats: None.
Source: Andrew F. G. Douse.
Criteria for inclusion: 123.

FRENCH GUIANA

INTRODUCTION

by **Jean-Luc Dujardin**

French Guiana, an overseas Department of France, has an area of about 88,900km^2, and is the smallest country on the South American mainland. The land rises gradually from the coastal plain to the higher slopes and savannas about 80 km inland. The only significant relief consists of the Inini-Camopi and Maripasoula Camopi hills, with peaks above 800m. In the extreme south-west, the peneplain is dominated by a series of isolated rock outcrops (inselbergs), the legendary Tumuc-Humac Mountains, with peaks up to 700m. The country is very well watered, and about twenty rivers enter the Atlantic along the 320 km of coastline. The coastal plain is characterized by extensive mangrove forests, fresh to brackish swamps, and seasonally flooded savannas, interspersed with patches of swamp forest and humid tropical forest on higher ground. The bulk of the interior (80,000km^2) is still covered in relatively undisturbed tropical forest. The climate is tropical with very heavy rainfall; the rainy season is from November to July, although there is sometimes a short dry period in February and March.

The total population of about 76,000 is almost entirely concentrated on the coastal plain, with over half in the city of Cayenne. There is a little agriculture, mainly rice growing, an industry involving the collection and pickling of the edible hearts of the palm *Euterpe oleracea*, and some shrimp farming on the coastal plain, while further inland the main activity is exploitation of forest resources. However, large tracts of the interior remain undisturbed except by hunters. Very large deposits of bauxite and kaolin have been discovered, and the exploitation of these is likely to increase greatly in the coming decades.

The only important wetland areas in the country are along the coastal plain where human population pressures are greatest. Large tracts of the coastal swamps have already been destroyed for agriculture and shrimp farming, and plans for agronomic expansion are threatening many other accessible areas. However, the very extensive marshes of the Kaw area, Pointe Behague and the lower River Oyapock in the east remain difficult of access and under no immediate threat.

Institutional Base for Wetland Conservation and Research

The governmental organization responsible for conservation in French Guiana (and also the French Antilles) is the Ministere de l'Environnement. However, in French Guiana this Ministry has to date been concerned only with agronomic development. The only organizations actively concerned with conservation are the Societe d'etude, de la protection et de l'amenagement de la nature en Guyane (SEPANGUY), and IBIS. Both societies are based in Cayenne, and have similar aims. SEPANGUY was established as a private conservation body in 1971, and is affiliated to the Societe pour l'etude, la protection et l'amenagement de la nature dans les regions inter-tropicales (SEPANRIT), based in Bordeaux, France. IBIS was established in 1983 and is a voluntary body concerned with the protection of wildlife.

The research bodies active in fields relevant to nature conservation are the Office de la recherche scientifique et technique Outre-mer (ORSTOM), based in Paris and with an office in Cayenne, and the Institut scientifique et technique des peches maritimes (ISTPM), also with an office in Cayenne.

The Office National des Forets (ONF) is primarily responsible for the management and exploitation of forests, and in France, manages forest reserves (reserves domaniales). It is likely that any future reserves in Guiana will first be established as forest reserves, and administered by ONF, but subsequent upgrading to some form of nature reserve will be necessary to ensure adequate habitat protection.

Progress in Wetland Conservation

No effective measures have as yet been taken to conserve wetlands or their wildlife in French Guiana. Numerous proposals have been made for the establishment of protected areas in the wetlands of the coastal plain, but none have been implemented. No less than eleven proposals for the creation of a reserve at Savane Sarcelle were submitted between 1971 and 1980, but these were abandoned in 1981 and a major rice growing project was initiated instead. However, the possibility of establishing a reserve somewhere in the coastal marshes of western French Guiana has not been entirely abandoned. A proposal was submitted in 1983 for the creation of a state reserve in the Marais de Kaw in the east, and it is anticipated that this proposal will have a better chance of success.

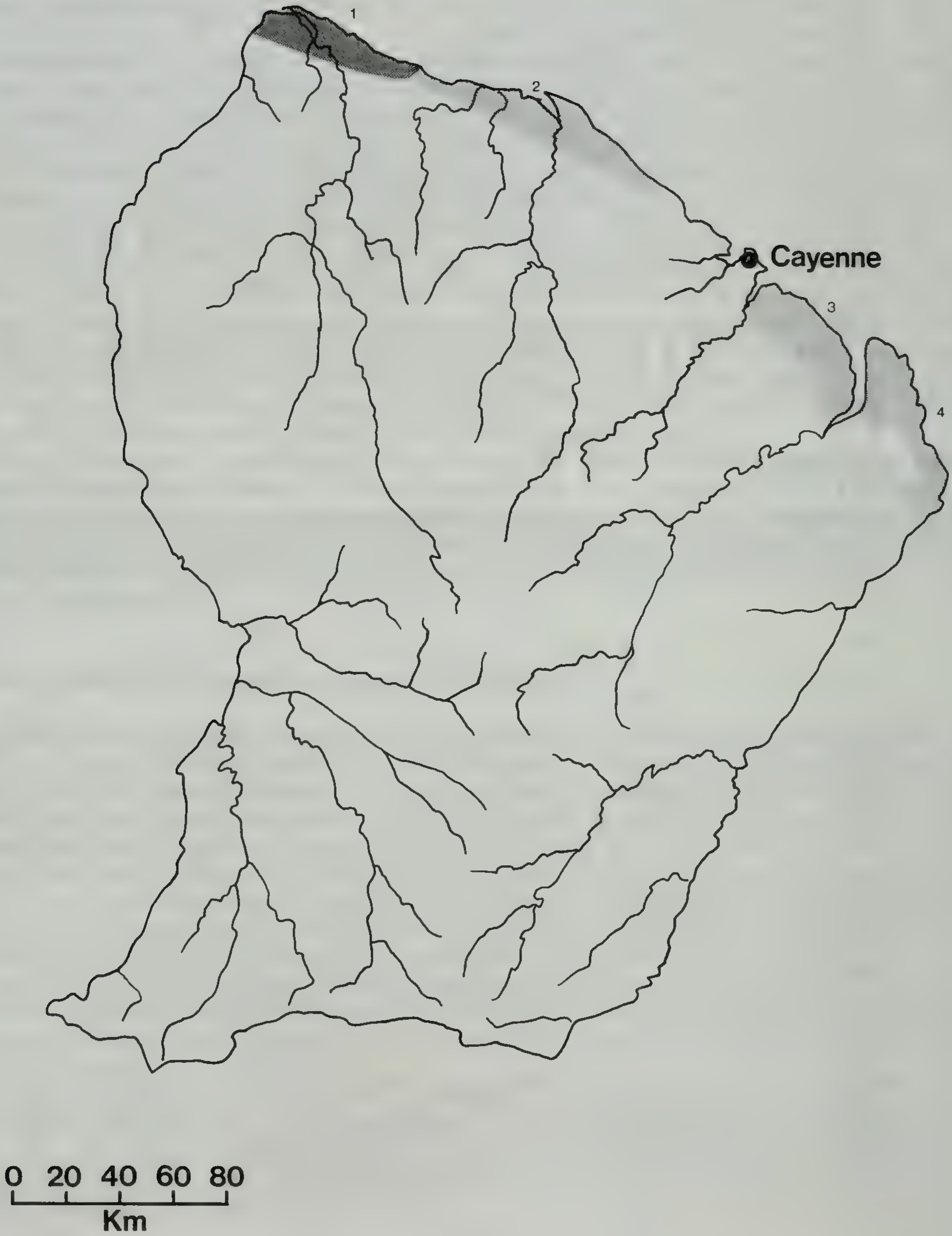
Some legislation has been passed concerning the hunting of wildlife: the hunting laws list a variety of fully protected and partially protected species, and establish hunting seasons and bag limits. However, hunting permits do not exist, insurance is not obligatory, enforcement of the regulations is almost non-existent, and the lists of protected and partially protected species are totally inadequate and ignored. Thus species such as the Ciconiidae, Cracidae, Rallidae, Charadriidae, Scolopacidae and Psittacidae appear nowhere on the lists and can apparently be hunted year round. Hunting is very popular and widespread, not only for food but also for trophies and for feathers for the artificial flower industry. This industry was developed in the Sinnamary area but is now expanding and poses a serious threat to such colourful species as *Eudocimus ruber*.

New hunting regulations are currently under study, but in the absence of any efficient means of control and with a lack of public awareness of the need to conserve wildlife, new regulations are unlikely to have any significant effect.

Acknowledgements

The author wishes to thank J. J. de Granville of ORSTOM, L. Sanite of SEPANGUY, and O. Tostain for their assistance in the preparation of this report and the following wetland accounts.

FRENCH GUIANA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WETLANDS

Site descriptions based on data sheets provided by Jean-Luc Dujardin.

Savane Sarcelle (1)

Location: 5°40'N, 53°45'W; 45 km ENE of St Laurent du Maroni.
Area: 34,700 ha (14,700 ha west of the Mana Estuary, 20,000 ha to the east).
Altitude: 0-1m.
Province and type: 8.4.1; 05, 07, 08, 12 & 13.
Site description: A broad strip of seasonal fresh to brackish coastal lagoons and marshes, up to 1m deep, with sandy beaches along the sea shore backed by mangroves. The marshes are flooded from the end of November to July, and dry out completely in September and October. Salinities range from 15 p.p.t. near the sea shore to 0.1 p.p.t. in the grassy marshes.
Principal vegetation: There are five main plant communities: the *Ipomoea pescaprae / Canavalia maritima* and *Mariscus ligularis / Sesuvium portulacastrum* communities in the littoral zone; and the *Eleocharis mutata / Avicennia germinans, Hydrocotyle umbellata / Jussieua leptocarpa* and *Montrichardia arborescens / Blechnum serrulatum* communities in the marshes. The *M. arborescens / B. serrulatum* community accounts for about 70-80% of the marsh vegetation.
Land tenure: Partly state owned, and partly owned by the communes of Mana and Iracoubo. Concessions for rice cultivation have been granted to two Dutch companies.
Protection: None.
Land use: Hunting, particularly during the period of construction of the Guianese Space Center at Kourou between 1968 and 1972. Large areas are now being developed for rice cultivation.
Waterfowl: The data are very incomplete and no estimates of total populations are possible. However the area is known to be of great importance for a wide variety of breeding, passage and wintering species, and over 75 species of waterfowl have been recorded. Breeding species include *Anhinga anhinga, Botaurus pinnatus, Ixobrychus exilis, Nyctanassa violacea, Egretta caerulea, E. tricolor, Mycteria americana, Dendrocygna autumnalis, Anas bahamensis, Cairina moschata, Aramus guarauna, Porphyrula flavirostris, Jacana jacana, Charadrius collaris, Himantopus himantopus* and *Sterna superciliaris. Tigrisoma lineatum, Cochlearius cochlearius, Euxenura maguari, Ajaia ajaja, Oxyura dominica, Rallus maculatus, Laterallus exilis, Heliornis fulica* and *Gallinago undulata* probably breed, and *Eudocimus ruber* is a common non-breeding visitor. The area is extremely important for wintering Nearctic shorebirds; in an aerial survey in January/February 1982, Morrison recorded 413,000 shorebirds between the Suriname border and Cayenne (this site and site 2). The majority were *Calidris* sandpipers, but there were also large numbers of *Numenius phaeopus, Limnodromus* sp and *Tringa melanoleuca/flavipes.* The area is also important for wintering *Anas discors.*
Other fauna: The area is rich in birds of prey including *Cathartes burrovianus, Rostrhamus sociabilis, Circus buffoni, Buteogallus aequinoctalis, B. urubitinga* and wintering *Pandion haliaetus* and *Falco peregrinus.* The beaches between Les Hattes and Organabo are one of the most important localities known for breeding Leatherback Turtles *Dermochelys coriacea.* Other reptiles include *Caiman crocodilus* and *Crotalus durissus dryinus.*
Threats: There is excessive hunting, with the almost systematic destruction of the wintering Anatidae, particularly *Anas discors*, and indiscriminate hunting of other species including *Mycteria americana* and *Eudocimus ruber.* Parts of the marshes are already being developed for rice cultivation, and the Direction d'Agriculture de Guyane has recently initiated a project for the polderization of a further 7,000 ha for rice production. The use of pesticides in nearby agricultural land is affecting some areas of marsh.
Research and conservation: Since 1971, eleven proposals have been made for the establishment of reserves in the area, but no action has been taken to date. In November 1979, a public enquiry was held to discuss the establishment of a 31,000 ha reserve, but this was ultimately rejected in favour of a major rice growing project. The possibility of establishing a reserve remains; a particularly suitable area would be some 6,000 ha north of the Mana River between Mana and Kawana Point, and including the marshes of Farez Point, with nesting *Ajaia ajaja* and *Mycteria americana.*

References: Rossignol (1972); Blancaneaux (1973); Condamin (1975); de Granville (1976 & 1979); Fretey (1982); Morrison (1983a); Association departementale d'Urbanisme et d'Amenagement de La Guyane (?).
Source: Jean-Luc Dujardin.
Criteria for inclusion: 123.

Coastal marshes of Sinnamary and Iracoubo (2)

Location: 5°27'N, 53°00'W; 100 km northwest of Cayenne.
Area: 55,000 ha (Kourou to Sinnamary 24,500 ha including 9,000 ha of mangroves; Sinnamary to Iracoubo 24,500 ha including 15,000 ha of mangroves; Iracoubo to Organabo 6,000 ha including 3,000 ha of mangroves).
Altitude: 0-2m.
Province and type: 8.4.1; 02, 06, 07, 08, 09, 13 & 16.
Site description: The estuaries of the River Sinnamary, River Iracoubo and numerous other smaller rivers, with intertidal mudflats and mangrove swamps; and a broad coastal strip of permanent and seasonal fresh to brackish marshes, up to 2m deep, behind a fringe of mangroves. Salinities are highest along the littoral zone and in the mangroves, and decrease progressively in the marshes. Maximum flooding of the marshes occurs in May and June, and by November, large areas are dry.
Principal vegetation: Mangrove swamps and saline marshes with *Avicennia germinans, Laguncularia racemosa, Spartina brasiliensis* and *Crenea maritima*; seasonally flooded marshes with *Scirpus maritimus, Eleocharis mutata* and *Sporobolus virginicus*; an herbaceous scrub zone dominated by *Rhynchospora corymbosa, Montrichardia arborescens, Blechnum serrulatum, Dryopteris gongylodes* and *Pityrogramma calomelanos*; and numerous scattered trees and shrubs, principally *Chrysobalanus icaco* and *Pterocarpus officinalis.*
Land tenure: Mainly owned by the communes of Sinnamary and Iracoubo, but a part in the east is owned by the Guianese Space Centre.
Protection: None.
Land use: Livestock rearing around Sinnamary, and rice cultivation in the region of Iracoubo. Intensive hunting for sport, food, the animal trade and the artificial flower industry.
Waterfowl: An extremely important area for breeding, passage and wintering waterfowl of a wide variety of species. *Eudocimus ruber* formerly nested in large numbers; in 1974, Condamin estimated the population at 6,000 pairs, but there has been a steady decline since then, and no evidence of nesting was found between 1981 and 1983. However, a colony of 300 pairs was located in the mangroves west of Kourou in July 1984. *Ajaia ajaja* also once nested, but is now only an occasional visitor. Species still breeding in the area include *Nycticorax nycticorax, Nyctanassa violacea, Cochlearius cochlearius, Egretta caerulea, E. tricolor, E. thula* and *Ardea cocoi.* An aerial census of Ardeidae and Threskiornithidae in April 1984 included 4,700 *Egretta thula, 4,350 E. caerulea, 2,600 E. tricolor, 465 E. alba* and 2,100 *Egretta ruber.* Although much persecuted by hunters, *Gallinago undulata*, still occurs in small numbers in the coastal savannas. The area is particularly important for wintering Nearctic shorebirds; an aerial survey of this area and adjacent coasts in January/February 1982 located 413,000 shorebirds, mainly *Calidris* sandpipers.
Other fauna: No information.
Threats: There is no direct threat to the mangroves or the marshes, but some elements of the avifauna are seriously threatened by intensive year round hunting. The taking of young birds for the animal trade, and the killing of species such as *Eudocimus ruber* and Psittacidae for their plumes for the local artificial flower industry have drastically reduced breeding populations.
Research and conservation: Several proposals for the establishment of reserves have been made since 1972, but no action has been taken to date. It is essential that an effective reserve be created to protect the breeding colonies of herons and ibises, and that the exploitation of wildlife be strictly controlled, if the local extinction of several species is to be avoided.
References: Condamin (1975); Lescure (1977); de Granville (1979); Morrison (1983a).
Source: Jean-Luc Dujardin.
Criteria for inclusion: 123.

Kaw Marshes (3)

Location: 4°45'N, 52°10'W; 35 km southeast of Cayenne.
Area: c.100,000 ha.
Altitude: 0-6m.
Province and type: 8.4.1; 02, 06, 07, 08, 09, 13, 16 & 18.
Site description: The estuaries of the Mahury, Approuague and Kaw Rivers, with intertidal mudflats and mangrove swamps, and a vast area of fresh to brackish marshes, seasonally flooded savanna and swamp forest behind a wide mangrove littoral zone. The marshes are 1-2m deep, and the salinity increases with depth. The savannas flood during the rainy season, and are dry from September to November.
Principal vegetation: Mangrove swamps in the littoral zone are dominated by *Avicennia germinans*; the estuarine mangrove swamps include a mixture of *Avicennia germinans, Rhizophora racemosa* and the palm *Euterpe oleracea.* Other plant communities include herbaceous marshes; marshy savanna with *Chrysobalanus icaco*; swamp forest with *Euterpe oleracea, Virola surinamensis* and *Chrysobalanus icaco*; seasonally flooded savanna with Cyperaceae, *Leersia hexandra* and *Echinochloa polystachya*; and "islands" of humid tropical forest on old raised beaches.
Land tenure: Partly state owned and partly owned by the communes of Roura and Regina.
Protection: None at present.
Land use: Cattle ranching and hunting in the vicinity of Kaw, and exploitation of the palm *Euterpe oleracea* on the banks of the River Approuague. The central portion of the marshes remains remote and undisturbed.
Waterfowl: Poorly known because of the difficulties of access, but clearly of great importance for a variety of breeding and wintering species. Birds observed during a brief aerial survey in April 1984 included 2,100 *Egretta caerulea, 1,000 Egretta tricolor, 2,350 Egretta thula, 220 Egretta alba* and 60 *Eudocimus ruber.* Other species recorded in the area and probably nesting include *Phalacrocorax olivaceus, Anhinga anhinga, Botaurus pinnatus, Ixobrychus exilis, Tigrisoma lineatum, Mycteria americana, Cairina moschata, Porphyrula martinica, P. flavirostris, Jacana jacana, Phaetusa simplex* and *Rynchops niger. Opisthocomus hoazin* nests along the lower Approuague and in the region of Kaw. The area is particularly important for wintering Nearctic shorebirds. 200,000 *Calidris pusilla* were observed in the Mahury estuary in November 1981, along with large numbers of ten other species of shorebirds and a variety of Laridae.
Other fauna: The Black Caiman *Melanosuchus niger* occurs; the Kaw Marshes are one of the few areas in South America where very large individuals of this rare species can still be found.
Threats: There are no immediate threats to the marshes. An attempt was made in the late 1950s to polderize the western part near the Mahury estuary for agriculture, but this scheme was abandoned in 1967. However, a Dutch group is now planning to purchase 6,000 ha in this area for shrimp farming and various agricultural projects. With the recent expansion of the palm industry in the east, there has been a significant increase in hunting activities, and a permit has recently been granted for the exploitation of palms within the area currently being proposed for the establishment of a reserve.
Research and conservation: A proposal for the establishment of a biological reserve has recently been deposited with the Office National des Forets.
References: Condamin (1975); de Granville (1979 & 1983).
Source: Jean-Luc Dujardin.
Criteria for inclusion: 123.

Pointe Behague and the lower River Oyapock (4)

Location: 4°20'N, 51°45'W; 80 km southeast of Cayenne.
Area: 148,000 ha.
Altitude: 0-6m.
Province and type: 8.4.1; 02, 06, 07, 08, 09, 13, 16 & 18.
Site description: The estuary of the Rio Oyapock on the Brazilian border, with intertidal mudflats and fringing mangroves; and a vast area of seasonally flooded savannas with small areas of permanent marsh, behind a broad coastal belt of mangroves. Surface waters are fresh

to brackish, but the water is saline at depths of 0.5m near the coast and 1.5m in the interior. The savannas flood in the rainy season, and dry out between August and November. There is some rocky relief in the middle of the marshes, with forested hills rising to 340m.

Principal vegetation: Mainly seasonally flooded savannas dominated by *Chrysobalanus icaco* and the palm *Euterpe oleracea.* Other plant communities include coastal mangrove swamps of *Avicennia germinans*; estuarine mangrove swamps with *A. germinans, Rhizophora racemosa* and *Euterpe oleracea*; herbaceous marshes; swamp forest with *E. oleracea* and *Virola surinamensis*; and gallery forest with *Mauritia flexuosa.* There is humid tropical forest on the hills.

Land tenure: Partly state owned, and partly owned by the communes of Ouanary and Regina.

Protection: None.

Land use: Hunting and fishing along the Ouanary and Courouaie Rivers; and exploitation of the palm *Euterpe oleracea* along the Approuague River in the west. There is no human activity in the greater part of the marshes.

Waterfowl: Very little information is available for this remote area, but it is known to be important for a variety of Ardeidae and wintering Nearctic shorebirds. Birds observed during an aerial survey in April 1984 included *2,150 Egretta caerulea, 1,050 Egretta tricolor, 2,400 Egretta thula, 95 Eudocimus ruber* and 45 *Ajaia ajaja. Opisthocomus hoazin* breeds along the Courouaie and Approuague Rivers. The tidal muflats in the estuary of the Oyapock and at Pointe Behague are important for shorebirds.

Other fauna: The isolated forested hills in the middle of the marshes have many colonies of *Rupicola rupicola. Melanosuchus niger* occurs in the marshes, and very large individualscan still be found.

Threats: There are no threats to the greater part of the marshes at the present time. However, with expansion in the palm industry around Regina, there has been an increase in hunting activities in the west and along the Courouaie River.

References: Condamin (1979); de Granville (1979).

Source: Jean-Luc Dujardin.

Criteria for inclusion: 2a, 2b & 3a.

GUYANA

INTRODUCTION

based on information provided by Lennox Bobb, Rhoeheit and Balram Singh

Guyana lies on the north coast of South America and is bounded in the west by Venezuela, in the east by Suriname, and in the south by Brazil. The total area is approximately 214,970km^2. The climate is humid tropical, with uniformly high temperatures (mean temperature in Georgetown 27°C), and an average annual rainfall of 2,000-2,500 mm. The main rainy season is from April to August, but there is a second peak between November and February, and the humidity remains high throughout the year.

The country is divided into three main regions: a narrow coastal plain (less than 5% of the country); the forested interior (85%); and the upland savannas and mountains of the southwest (10%). The 320 km long coastal plain, although generally less than 12 km wide, supports 90% of the country's population of about 800,000. Early Dutch settlers drained many of the wetlands, and most of the central and eastern coastal plain is now intensively cultivated for sugar cane and rice. The plain is crossed by several great rivers such as the Essequibo, Demerara, Berbice and Corantyne, which rise in the interior. The hilly interior of the country rises gradually from the coast to the high plateau in the southwest. There is little human settlement or cultivation; the soils are poor and sandy, and most of the land remains under primary forest cover. The uplands of the southwest, including the Rupununi and Kanaku mountains, comprise a part of the Guiana Highlands, a region of rolling savannas and rocky peaks rising to over 2,000m. There is a small indigenous population now dependent mainly on cattle ranching.

Institutional Base for Wetland Conservation and Research

The Parks Commission in the Ministry of Energy and Natural Resources was originally the authority for identifying, establishing and managing national parks and reserves, but is now concerned only with recreation areas. The Wildlife Committee in the Ministry of Agriculture assumed responsibility for nature conservation, but since the death of its former chairman, Prof. Joseph Nilkes, the Committee has been concerned almost exclusively with trade in wildlife, especially Psittacidae. A proposal was made in 1979 to set up a Wildlife Unit in the Ministry of Agriculture with its own administrative and technical staff, but no progress has been made to date.

In 1982, the National Science Research Council founded an Environmental Research Unit, and this is now the only organization primarily concerned with environmental conservation. Its major activity to date has been the collection of basic data. The Guyana National Museum, although not involved directly with conservation, has conducted some research on wildlife, and until 1980, published its results in the journal "Timehri". The Institute of Applied Science and Technology at the University of Guyana also conducts research on wildlife, and has a representative in the Wildlife Committee.

Progress in Wetland Conservation and Research

Legislation concerning parks and reserves dates from 1929, but only one national park has as yet been established, the Kaieteur National Park (11,655 ha) in the forested interior. Very comprehensive game laws were introduced in the 1970s. The Wild Birds Protection Act of 1973 and its amendment of 1978 give complete protection to most birds, permitting open seasons for only a small number of game species, while the Fisheries Act of 1973 covers not only marine and freshwater fishes but also reptiles. Unfortunately, the game laws are largely ignored and trade in protected wildlife continues at a high level. However, there are strict controls on firearms and only some 200 licensed hunters in the country; thus shooting pressure in very light.

Little research has been conducted on wetlands and/or waterfowl, and most of this has been carried out by visiting biologists from abroad. Recent work has involved the following:

a) Surveys of wintering shorebirds and terns *Sterna* spp along the coast, by the Canadian Wildlife Service and Manomet Bird Observatory (Blokpoel *et al*, 1982; Morrison *et al*, 1985; B. A. Harrington, pers. com.).
b) Studies of *Dendrocygna autumnalis* and *Rostrhamus sociabilis* in coastal wetlands, by Bourne (1979, 1981 & in prep.) and Bourne & Osborne (1978).
c) Surveys of breeding *Eudocimus ruber* and other Ciconiiformes in the coastal zone, by Spaans (1975a) and the World Working Group on Storks, Ibises and Spoonbills (C. Luthin, pers. com.).

The Environmental Research Unit has recently acquired funding for a small research team to undertake a survey of Guyana's wetlands, and it is anticipated that this will be completed during the course of 1985.

Major Threats to Wetlands and Waterfowl

Nothing is known of the current threats to wetlands in Guyana. Sport hunting is not considered to pose a threat to waterfowl populations, but there is a considerable amount of subsistence hunting, and market hunting is reported to be on the increase. Migrant shorebirds and terns are commonly trapped for food along the coast, and this may be having a detrimental effect on some species, particularly *Sterna hirundo* and other terns (Blokpoel *et al*, 1982).

WETLANDS

Insufficient information is available on the wetlands of Guyana for the identification of sites of special importance. The following brief accounts of wetlands in the three major regions of the country are based on information from Brian A. Harrington, David Willis and the literature.

The Coastal Zone

The shoreline of Guyana west of the Essequibo River is for the most part a narrow coral sand beach, of little importance for waterfowl. From the estuary of the Essequibo River east to the estuary of the Corantyne River on the Suriname border, there are tidal mudflats, sand flats and patches of mangrove swamp of considerable importance for a variety of Ciconiiformes and migrant shorebirds and Laridae. In an aerial survey of this eastern coast in February 1982, Morrison *et al* (1985) recorded 885 *Eudocimus ruber* and almost 27,000 shorebirds, mainly *Pluvialis squatarola, Tringa melanoleuca/flavipes, Limnodromus* sp and *Calidris* spp. Spaans (1975a) found breeding colonies of *Eudocimus ruber* in the Mahaicony region in 1972 (600 pairs) and 1976 (300 pairs), but no colonies were located in 1982 or 1983. An aerial survey of the entire coast in the summer of 1983 did however locate two large mixed colonies of Ardeidae; a colony of 2,000-3,000 pairs of small herons and egrets 12 km east of the Abary River, and a colony of 100 pairs of *Egretta alba* and 500-1,000 pairs of small herons and egrets at the mouth of the Berbice River. Other birds recorded during this survey included 30 *Pelecanus occidentalis* and 130 *Ajaia ajaja* near the estuary of the Essequibo River. In February 1984, there was a roost of several thousand Ardeidae of six species and a breeding colony of several hundred pairs of *Nycticorax nycticorax, Bubulcus ibis* and *Egretta thula* in the Botanic Gardens on the outskirts of Georgetown.

Inland, the coastal plain is intensively cultivated, and there are few if any large natural wetlands remaining. However, the rice paddies and wet meadows provide rich feeding areas for many Ardeidae, *Dendrocygna* spp and migratory shorebirds.

The Interior

There are extensive tracts of swamp forest and riverine marshes in the forested interior of the country. The region of Lethem and Manari on the Brazilian border in the southwest is known to be particularly rich in wetlands. Here, along the Rio Tacutu, a tributary of the Rio Branco in the Amazon drainage, there are many small lakes and swamps important for waterfowl. Species recorded include *Pilherodius pileatus, Jabiru mycteria, Dendrocygna viduata, Amazonetta brasiliensis, Porphyrula flavirostris, Rynchops niger* and many migratory shorebirds (notably *Bartramia longicauda* and *Micropalama himantopus*) (D. Willis, pers. com.)

The Grand Savanna

The upland savanna of western Guyana is an extension of the Gran Sabana of eastern Venezuela. There are many small freshwater lakes and bogs throughout the region, but their importance for wildlife is unknown.

PARAGUAY

INTRODUCTION

by **Nancy E. Lopez**

Paraguay occupies an area of 406,752km^2 and, according to the 1982 census, has a population of some 3,563,000.

The Rio Paraguay divides the country into two regions; the "Oriental" and the "Occidental". The Oriental region, which includes the Rio Paraguay and Alta Parana regions, is a rolling plain interrupted by hills and low mountain ranges with elevations ranging from 80m to 850m. The majority of Paraguay's population lives in this region. The Occidental region, which includes the Alto Chaco and the Bajo Chaco, is a vast alluvial plain at about 130m sloping gradually down to the Rio Paraguay in the east.

The hydrological systems of Paraguay are part of the great basin of the Rio de La Plata. The Rio Parana and the Rio Paraguay are the most important rivers in this basin, both in terms of length and flow. Of the rivers flowing across the Paraguayan Chaco, one of the most important is the Pilcomayo, a shallow river with erratic course. In the basin of the Rio Paraguay, there are extensive wetland systems including the Pantanal Matogrosense, the Bajo Chaco, the seasonally flooded plains and swamps of the Yetyty, and the seasonally flooded plains and marshes of the eembucu. The Rio Pilcomayo feeds a zone of the Bajo Chaco known as the Estero de Patino, but this swamp can dry out during certain periods of the year because of the instability of the course of the Pilcomayo.

Lago Ypacarai, Lago Ypoa and Laguna Vera are the most important lakes in the country; all three are fed by tributaries of the Rio Paraguay.

In the Alto Chaco there are some temporary lagoons, but these have not been adequately surveyed.

According to Hueck (1978), Paraguay has the following principal vegetation types:

a) Deciduous and mesophytic subtropical forest; occurring throughout the mountainous areas and characteristically with trees 25-30m in height, dense undergrowth, and abundant lianas and epiphytes.
b) Dry forest of the central Chaco; open xerophytic woodland with few trees over 20m in height and most with small leaves. Common species include *Prosopis* sp, *Schinopsis* sp, *Aspidosperma* sp and *Bulnesia sarmentoi.* Gallery forest and scrub occur along river courses.
c) Dry to sub-humid forest of the eastern Chaco; principally palm savanna dominated by extensive open stands of the palm *Copernica australis (Copernicia alba).*
d) Mesopotamian parkland; occurring along the edge of the Chaco where the water table is high and flooding is frequent. This is characterized by extensive marshes, wet savannas, gallery forest and scattered "islands" of forest and scrub. Agriculture has destroyed a large part of this type of vegetation.
e) Cerrado; a vegetation type resembling savanna but with scattered trees, characterized by the presence of small trees, numerous shrubs and a ground cover of grasses and herbs.
f) Campos limpios; open grassland alternating with belts and "islands" of forest.
g) Pantanal vegetation; wet savannas inundated during the rainy season.
h) Gallery forest; belts of forest of varying width along river courses, with species such as *Salix humboldtiana* and *Tessaria integrifolia.* The height of the trees ranges from 8-20m.

Institutional Base for Wetland Conservation and Research

Governmental

Ministerio de Agricultura y Ganaderia - Servicio Forestal Nacional: responsible for the management and administration of the national parks.

Ministerio de Defensa Nacional: cooperates with the Servicio Forestal Nacional in the administration of the Parque Nacional Cerra Cora and other historical sites in the country, and is involved in the wardening of the Parque Nacional Teniente A. Enciso.

Instituto de Bienestar Rural: subject to the agreement of other relevant institutions, this institute has the authority to designate national parks in areas of special geographical, historical or touristic interest and in areas of special importance for the preservation of fauna and flora. Once established as national parks, these areas are not transferable and can only be exploited for scientific, cultural and touristic purposes.

Direccion General de Turismo: responsible for the conservation and improvement of the country's scenic attractions.

Universidad Nacional de Asuncion - Instituto de Ciencias Basicas: responsible for conservation education at university level and for scientific research.

Non-governmental

Sociedad Paraguaya para Proteccion de la Naturaleza (PRONATURA): created in 1976 and dedicated to environmental education as a means to increase public awareness of the importance of natural resources and the need to conserve them.

Others

American Peace Corps: provides support through programmes of environmental education and research.

Progress in Wetland Conservation and Research

Nine protected areas have been established in Paraguay, and a further five are currently at the project stage. These are as follows:

- Parques Nacionales
    - Defensores del Chaco (780,000 ha), established in 1975.
    - Tinfunque (280,000 ha), established in 1966.
    - Teniente A. Enciso (40,000 ha), established in 1980.
    - Cerro Cora (5,538 ha), established in 1976.
    - Ybycui (5,000 ha), established in 1973.
    - Yacyreta (17,000 ha), in the project stage.
    - Nueva Asuncion (96,000 ha), in the project stage.
- Reservas Nacionales
    - Kuriy (2,000 ha), established in 1973.
- Bosques Protectores
    - Jakuy (1,000 ha), established in 1975.
    - Ñacunday (1,000 ha), established in 1975.
    - Caazapa (6,000 ha), established in 1976. (Currently named Parque Nacional Caaguazu).
    - Cerro Guazu (10,000 ha), in the project stage.
    - Cerro Cora (area unknown), in the project stage.
- Reservas Forestales
    - Capiibary (9,000 ha), in the project stage.

The majority of these protected areas include important tributary rivers and streams of the Rio Parana and Rio Paraguay.

In the Plan Preliminar de Sistemas de Areas Nacionales Protegidas del Paraguay, prepared by SFN/MAG in 1983, the following proposals were made:

a) to include the pantanal vegetation and humid forest as new units of conservation, under both private and state ownership;
b) to protect the threatened ecosystem of the Pantanal Matogrosense;
c) to include a sample of lakes in the system of protected areas;
d) to conduct appropriate studies and establish protected areas as follows:
    - a nature reserve or wildlife reserve under state or private ownership in the Mesopotamian parkland and humid forest in the departments of Misiones and/or Ñeembucu;
    - a wildlife reserve under state or private ownership in the Lago Ypoa or Laguna Vera region;

a multiple use zone and forest reserve in the Capiibary region, in the Department of San Pedro;

e) to reclassify the Bosque Protector Ñacunday as an Area Nacional de Recreacion..

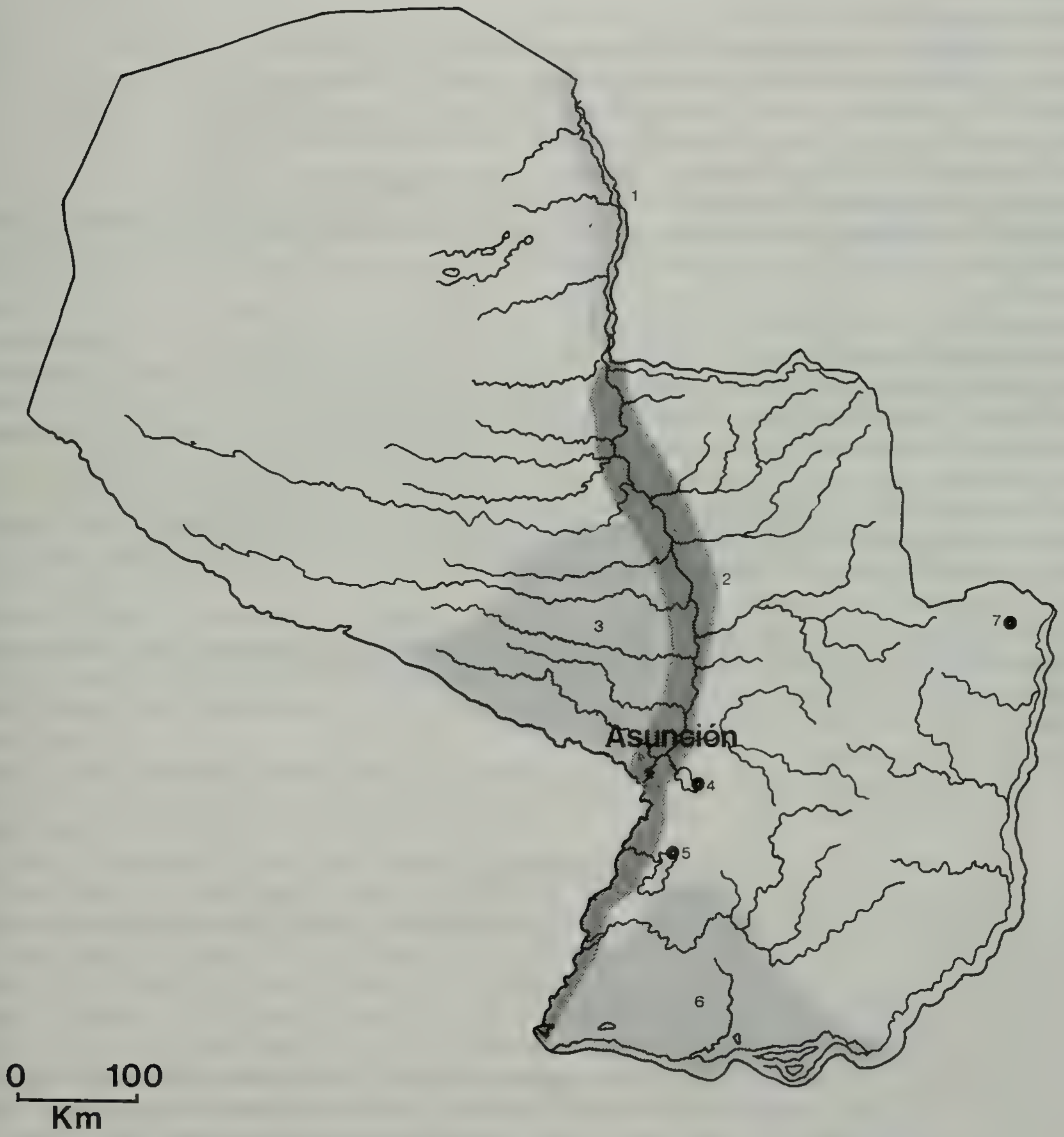
Since 1977, the Servicio Nacional Forestal and the American Peace Corps have been carrying out a programme which includes national park planning, a forestry project, environmental education and a biological inventory. It is hoped that this programme will promote the development of an efficient and viable institutional base for the management of natural resources. The Ministerio de Defensa Nacional, the Cooperacion Suiza para el Desarrollo (COSUDE) and other organizations have given assistance in the planning of national parks. The forestry project was initiated in 1981 with a view to promoting an efficient system of forestry for improved land management, and has been carried out with the collaboration of the Servicio de Extension Agricola y Ganaderia, the Corporacion Tecnica Suiza and US-AID. Activities in environmental education have been conducted in conjunction with the Ministerio de Educacion y Culto and with the Centros Regionales de Educacion. The biological inventory began in 1980 and is currently compiling basic information on the taxonomy, ecology, distribution and natural history of the fauna and flora of Paraguay. The inventory includes wetlands and waterfowl, and is attempting to centralize all the information obtained by creating a National Museum of Natural History (the Museo Nacional de Historia Natural).

In 1968, the Instituto de Ciencias Basicas at the Universidad Nacional de Asuncion began to conduct research on the ecology and pollution of the Lago Ypacarai basin, and this work continues.

Major Threats to Wetlands and Waterfowl

There are many threats to the principal wetlands and their avifauna in Paraguay. The most obvious are the uncontrolled destruction of forests and the drainage of natural wetlands for agriculture and livestock grazing. Another problem affecting wetlands is the high level of pollution from industrial waste. Uncontrolled sport hunting and the illegal trade in wildlife have affected the populations of some waterfowl, but no precise data are available on this.

PARAGUAY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WETLANDS

Site descriptions based on data sheets prepared by Nancy E. Lopez of the Servicio Forestal Nacional. The information on reptiles and amphibians was provided by Aida L. Aquino, and that on mammals by Len West.

Pantanal Matogrosense (1)

Location: 19°40'-21°40'S, 58°00'W; along the Brazilian border, Alto Paraguay Department.
Area: 400,000 ha.
Altitude: 96m.
Province and type: 8.8.2; 09, 11, 12, 13, 16 & 18.
Site description: A continuation of the pantanal system of southwestern Brazil and southeastern Bolivia, extending south along the west bank of the Rio Paraguay to 70 km north of Puerto Casado. A vast area of humid palm savanna, with numerous small permanent freshwater lakes, streams and marshes; subject to inundation during the wet season (October to March) and with the flooding of the Rio Paraguay. Gallery forest and riverine thickets occur along the Rio Paraguay and permanent stream courses.
Principal vegetation: Characteristic marsh vegetation includes species of *Eichhornia*, *Azolla* and *Pistia*, and various Cyperaceae; the palm savannas are dominated by the palm *Copernicia australis*.
Land tenure: Privately owned.
Protection: None.
Land use: Palms were formerly harvested for electricity poles. The area is very remote and difficult of access, but illegal hunters enter the area by boat.
Waterfowl: Very poorly known, but certainly an important area for waterfowl characteristic of the pantanal. All three Ciconiidae and many Ardeidae and Threskiornithidae are common, and *Phoenicopterus chilensis* has been recorded as a non-breeding visitor.
Other fauna: Little information. The Tapir *Tapirus terrestris*, Jaguar *Leo onca*, the bat *Noctilio leporinus*, the iguana *Dracaena paraguayensis*, and the caimans *Caiman crocodilus* and *C. latirostris* are known to occur.
Threats: Illegal hunting may pose a threat to some species.
Research and conservation: The need for a thorough faunal and floral survey of this important area is evident.
Source: Nancy E. Lopez.
Criteria for inclusion: 123.

Rio Paraguay (2)

Location: 22°00'-27°15'S, 57°10'-58°30'W; between Puerto Caballo and Paso de Patria, central Paraguay.
Area: 1,265 km of river.
Altitude: 50-87m.
Province and type: 8.8.2/8.21.4; 10 & 11.
Site description: The relatively fast-flowing Rio Paraguay, with numerous sandy and muddy beaches and islands, and bordered with riverine forest; from the Brazilian border in the north to the Argentinian border in the south. The river level fluctuates widely, and at low water levels, extensive mud banks are exposed.
Principal vegetation: In the dry to subhumid eastern chaco woodland zone, with some semi-deciduous and mesophytic forest.
Land tenure: State owned.
Protection: None.
Land use: There are numerous towns and villages along the river, and there is a considerable amount of boat traffic. International conventions define the use of the Rio Paraguay for navigation.

Waterfowl: The sandy beaches and mud banks are important for a wide variety of passage and wintering waterfowl. Birds observed during a survey of part of the river in January 1984 included 40,000 *Phalacrocorax olivaceus*, 1,000 *Anhinga anhinga*, 4,000 *Ardea cocoi*, 300 *Egretta alba*, 200 *Syrigma sibilatrix*, 100 *Mycteria americana*, 20 *Jabiru mycteria*, 100 *Ajaia ajaja*, 300 *Amazonetta brasiliensis*, and 15 species of Nearctic shorebirds. Winter visitors from the south include *Coscoroba coscoroba*, *Cygnus melancoryphus* and *Netta peposaca*, and *Neochen jubata* and *Sarkidiornis melanotos* have been recorded.
Other fauna: *Caiman crocodilus yacare* and *C. latirostris* still occur along the river.
Threats: Pollution from industry and human settlements along the river banks must be a problem, but the levels of pollutants in the river are as yet unknown.
Research and conservation: There is a clear need for detailed studies of the riverine ecosystems, and the establishment of reserves in key areas.
Source: Nancy E. Lopez.
Criteria for inclusion: 123.

The Pantanal of the Eastern Chaco (3)

Location: 23°10'-25°10'S, 57°20'-60°00'W; west of the Rio Paraguay between Asuncion and Concepcion, Presidente Hayes Department.
Area: 4,500,000 ha.
Altitude: 100m.
Province and type: 8.21.4; 09, 11, 12, 13 & 16.
Site description: A vast area of seasonally flooded grassland and palm savanna, with numerous small permanent freshwater lakes, impoundments, and marshes; fed by tributaries of the Rio Paraguay. During the dry season, from April to August, most of the area dries out completely, but with the rains and flooding from the rivers, extensive areas are inundated to a depth of 1-2m.
Principal vegetation: The permanent marshes have an abundant growth of *Eichhornia*, *Azolla* and *Pistia*; the dominant palm of the savannas is *Copernicia australis*; and there are patches of riverine forest along the major stream courses. The region is within the dry to subhumid chaco woodland zone.
Land tenure: Most of the area is privately owned in large estancias.
Protection: The only protected area is the Tinfunque National Park (280,000 ha); although the park was established in 1966, no management plan has ever been produced for it. However, a number of the private landowners take an interest in conservation, and several prohibit hunting on their property.
Land use: Cattle ranching. Much of the *Copernicia australis* has been cleared to provide more grazing land, and burning is common. Steel factories in Villa Hayes utilize timber from the chaco for fuel.
Waterfowl: An extremely important area for waterfowl, particularly at the end of the dry season (July/August) when large concentrations of fish-eating birds congregate around the few remaining water bodies, and during the breeding season (September to March). About 70 species have been recorded, the most abundant including *Nycticorax nycticorax*, *Egretta thula*, *E. alba*, *Ardea cocoi*, *Mycteria americana*, *Euxenura maguari*, *Jabiru mycteria*, *Theristicus caudatus*, *Phimosus infuscatus*, *Dendrocygna autumnalis*, *Amazonetta brasiliensis*, *Cairina moschata*, *Jacana jacana* and *Vanellus chilensis*. Other species occurring in significant numbers include *Syrigma sibilatrix*, *Harpiprion caerulescens*, *Chauna torquata*, *Anas leucophrys*, *Sarkidiornis melanotos*, *Aramides ypecaha* and a variety of Nearctic shorebirds.
Other fauna: The area is very rich in birds of prey, with large populations of *Cathartes burrovianus*, *Rostrhamus sociabilis* and *Busarellus nigricollis*. Mammals include *Chrysocyon brachyurus*, *Pteronura brasiliensis*, *Hydrochoerus hydrochaeris*, *Myocastor coypus*, *Leo onca* and *Blastocerus dichotomus*. Reptiles include *Caiman crocodilus*, *C. latirostris*, *Hydromedusa tectifera* and *Hydrodynastes gigas*.
Threats: An expansion of ranching activities may reduce the extent of wetland habitat, and heavy hunting pressure may be threatening some species.
Research and conservation: Detailed surveys with a view to the establishment of additional protected areas, and development of suitable land use plans are urgently required.

References: Bertoni (1930); Short (1975 & 1976); IUCN (1982); Peris *et al* (in press.)
Source: Nancy E. Lopez.
Criteria for inclusion: 123.

Lago Ypacarai (4)

Location: 25°17'S, 57°20'W; 25 km east of Asuncion, Central Department.
Area: 5,328 ha.
Altitude: 64m.
Province and type: 8.8.2; 12.
Site description: A permanent shallow freshwater lake, up to 1.8m deep, with associated marshes in rolling hill country.
Principal vegetation: Marshes with *Eichhornia* sp, *Pistia stratiotes, Cyperusgiganteus* and *Acrocomia totai*. The native forests of the surrounding area have been largely destroyed.
Land tenure: Privately owned.
Protection: None at present.
Land use: Cattle ranching; wood-cutting; water sports and other recreation; and some industry nearby.
Waterfowl: Formerly an important area for waterfowl, but now the area is rather impoverished, presumably as a result of pollution and excessive disturbance.
Other fauna: The Marsh Deer *Blastocerus dichotomus* apparently still occurs in the area along with *Ozotoceros bezoarticus*. Reptiles include *Eunectes noteus, Hydrodynastes gigas, Phrynops geoffroanus* and *Hydromedusa tectifera*.
Threats: There is a serious pollution problem from effluents from several factories near the lake and domestic waste from housing along the shore. Native forests around the lake have been destroyed, and much of the shoreline is being developed for housing.
Research and conservation: A commission has recently been established to afford protection to the lake and to reduce the level of pollution. Ypacarai is of particular interest in that it is one of the very few wetlands of its kind in the country. Limnological studies have been conducted by Gonzalez Romero and Arzamendia.
References: Gonzalez Romero & Vera (1968); Gonzalez Romero & Arzamendia (1979 & 1983).
Source: Nancy E. Lopez.
Criteria for inclusion: 2a, 2b & 3a.

Lago Ypoa (5)

Location: 25°48'S, 57°28'W; 30 km west of Acahay, Central, Paraguari and Ñeembucu Departments.
Area: 18,200 ha.
Altitude: 100m.
Province and type: 8.8.2; 12.
Site description: A group of permanent freshwater lakes centered on Lago Ypoa, with extensive marshes, scattered palm groves and isolated patches of forest. The lakes are fed by a number of small streams, and the water levels fluctuate according to local rainfall. The lakes lie at the northern extremity of the great pantanal of southern Paraguay.
Principal vegetation: Marshes with *Cyperus giganteus* and *Eichhornia* sp; and the palm *Copernicia australis*.
Land tenure: Privately owned.
Protection: None.
Land use: Cattle ranching and some agriculture, mainly in the north and east; and some hunting. The southern part of the area is remote and little disturbed.
Waterfowl: Poorly known, but apparently not very important for waterfowl.
Other fauna: The area is an important centre for the rare Marsh Deer *Blastocerus dichotomus*, and the Maned Wolf *Chrysocyon brachyurus* is reported to occur. Reptiles include *Eunectes noteus, Phrynops nasuta, Hydromedusa tectifera* and at least one species of *Caiman*.

Threats: Drainage for agriculture poses the most serious threat; there was a proposal to drain some 40,000 ha of wetlands in the area, but this was abandoned. A considerable amount of illegal hunting also takes place.
Research and conservation: A proposal has been made to include Lago Ypoa and wetlands to the south in a Faunal Reserve, but no action has been taken to date. Further studies are required of this important lacustrine system.
Source: Nancy E. Lopez.
Criteria for inclusion: 2a & 3a.

Pantanal de Ñeembucu (6)

Location: 26°30'-27°20'S, 56°30'-58°30'W; southern Paraguay, in the Departments of Paraguari, Misiones and Ñeembucu.
Area: 800,000 ha.
Altitude: 65m.
Province and type: 8.21.4; 09, 11, 12, 13 & 16.
Site description: The pantanal of southern Paraguay, extending from the confluence of the Paraguay and Parana Rivers in the southwest to the region of Lago Ypoa in the north, and Ayolas on the Parana in the east. A vast complex of permanent and seasonal freshwater lakes and marshes, slow-flowing rivers and riverine marshes, and seasonally inundated grassland and palm savanna, with gallery forest along the permanent water courses. The water table is high, and extensive tracts of marsh along the Paraguay and Parana are permanent, but there are wide fluctuations in water level, and during the wet season, large areas of grassland and palm savanna are flooded to a depth of 0.5-1m.
Principal vegetation: Lakes and ponds with species of *Eichhornia*, *Azolla* and *Pistia*; marshes with Cyperaceae; and palm groves of *Copernicia australis*.
Land tenure: Privately owned in large estancias.
Protection: No legal protection at present. On several estancias, hunting is prohibited.
Land use: Cattle ranching; some agriculture; subsistence fishing; and sport and commercial hunting.
Waterfowl: A very important area for breeding, passage and wintering waterfowl, with all the characteristic pantanal species occurring. The area is however poorly known; no censuses have been undertaken, and the key sites have not as yet been identified. Some of the more interesting species occuring in the region include *Jabiru mycteria*, *Harpiprion caerulescens*, *Coscoroba coscoroba*, *Cygnus melancoryphus*, *Neochen jubata*, *Sarkidiornis melanotos*, *Heteronetta atricapilla* and a variety of Nearctic shorebirds.
Other fauna: Mammals include the Marsh Deer *Blastocerus dichotomus* and Maned Wolf *Chrysocyon brachyurus*; and reptiles include *Eunectes noteus*, *Hydrodynastes gigas*, *Phrynops geoffroanus* and *Hydromedusa tectifera*.
Threats: The area is at present relatively undisturbed, but potential threats include large scale drainage for ranching and agriculture, and increased human settlement with the construction of roads through the region. Excessive commercial hunting poses a threat to some species.
Research and conservation: A proposal has been made to include Laguna Vera in the north in a Faunal Reserve, along with the nearby Lago Ypoa. There is a great need for detailed studies of the area while it remains in a relatively pristine condition, so that key areas can be protected, and any future development carried out on a rational basis.
Source: Nancy E. Lopez.
Criteria for inclusion: 123.

Rio Carapa (7)

Location: 24°10'S, 54°37'W; 15 km west of Colonia Catuete, Canindeyu Department.
Area: 150 km of river.
Altitude: 350m.
Province and type: 8.8.2; 10 & 11.

Site description: A small fast-flowing tributary of the Rio Parana with many rapids, flowing through humid subtropical forest and dense bamboo thickets. The upper drainage is in cerrado country, with riverine forest, bogs and wet grassland along the stream courses.

Principal vegetation: In an area of almost undisturbed humid subtropical forest.

Land tenure: No information.

Protection: None.

Land use: Some agriculture and exploitation of forests.

Waterfowl: The very rare Brazilian Merganser *Mergus octosetaceus* was observed on the Rio Carapa in February 1984 by Lopez; this constitutes the first record of the species in Paraguay for many years. The Rufous-faced Crake *Laterallus xenopterus* was recently discovered in an area of wet grassland only 50 km southwest of the upper Carapa drainage (Myers & Hansen, 1980), and presumably occurs in the Carapa drainage.

Other fauna: No information.

Threats: There is active colonization in the area.

Research and conservation: There are now very few undisturbed riverine systems in this part of the continent, and species such as *M. octosetaceus*, dependent on clear-water rivers and streams, are becoming increasingly rare. The establishment of protected watersheds in this region is obviously a high priority.

References: Myers & Hansen (1980).

Source: Nancy E. Lopez.

Criteria for inclusion: 2a, 2b & 3a.

PERU

INTRODUCTION

based on information provided by Eric Cardich, Victor Pulido and Manuel Rios

Peru is situated in west-central South America and has a coastline on the Pacific Ocean stretching for 3,080 km from the Ecuadorean border in the north to the Chilean border in the south. Its total area, including offshore islands and the Peruvian part of Lake Titicaca, is 1,285,216km^2, and its population is currently estimated at 18,280,000. The country lies entirely within the Southern Hemisphere tropics and can be divided into three distinct regions, the Pacific, Andean and Atlantic. The main climatic zones are as follows:

Pacific Region
a) The tropical zone with three months of rainfall and a mean temperature of 24.3°C; in the extreme north of the coastal zone from the Ecuadorean border south to about 5°S.
b) The arid subtropical zone with the little rainfall occurring during the austral winter, and mean temperatures ranging from 19-23°C; from the Rio Chira south to the Chilean border.

Andean Region
a) The Pacific slope with a climate transitional between that of the coast and that of the Andean puna. Mean temperatures range from 13-15°C, and rain falls during the austral summer; winters are dry and temperate.
b) The Puna zone with a cold and humid climate, and frequent mists and snow on the higher mountains.
c) Inter-Andean valleys with very varied climates, but generally with greater extremes in temperature and less rainfall than the puna; some of the deeper valleys have very little rainfall and support desertic vegetation.
d) The cloud zone of the eastern Andes, at altitudes between 2,500 and 3,500m; temperatures are low and rainfall is high.
e) The alpine zone, above 4,800m on the highest peaks of the Andes, south of latitude 8°S.

Atlantic Region
a) The upper humid forest zone, at altitudes between 500 and 2,000m; mean temperatures range from 21 to 28°C, rainfall is high (maximum 3,000 mm), and there is a dry season from July to September.
b) The lowland humid forest zone, below 500m; mean temperatures are above 25°C, annual rainfall is in the region of 2,000 mm, and there is a well defined dry season during the austral winter. This is the typical climate of the Amazon lowlands throughout eastern Peru.

The Pacific watershed comprises about 21.8% of Peruvian territory, the Atlantic watershed 74.4%, and the Titicaca basin 3.8%. A recent inventory of lakes and dams in the Andean and Pacific regions of Peru by the Oficina Nacional de Evaluacion de Recursos Naturales identified 12,201 water bodies, 3,896 in the Pacific drainage, 7,441 in the upper Atlantic drainage, 841 in the Titicaca basin and 23 in the Huarmicocha basin (ONERN, 1980).

Parker *et al* (1982) recognize twenty-three major habitat types in Peru, ten of which are, or include, important wetland habitat. These are as follows:

a) Humid low-lying forest. This includes seasonally inundated forest and permanently swampy forest, usually bordering rivers. Most flooding occurs during or just after the rainy season, from November to May. Fig trees *Ficus* spp are common in the seasonally flooded forest, and the palm *Mauritia* sp is characteristic of the swamps. Extensive stands of these palms are known as "aguajales". Seasonally flooded forest along the banks of the larger tributaries of the Amazon is often called "varzea".

b) Tropical savanna. Savanna with scattered shrubs and palms, especially *Mauritia* sp, subjet to flooding during the rainy season. This habitat is almost confined to a small area along the Rio Heath in extreme southeast Peru.

c) Tropical rivers and their margins. Rivers with sandy or muddy shores, riverine thickets on newly formed sand banks with colonizers such as *Salix* sp and *Tessaria* sp, and later successional stages with *Cecropia sp, Ficus sp, Erythrina sp*, etc. Dense stands of the tall cane *Gynerium* sp are also typical of this habitat type, which is often called "zabolo".

d) Oxbow lakes and their margins. Oxbow lakes are numerous along most of the meandering river course in the lowlands of eastern Peru. The aquatic vegetation includes floating mats of *Paspalum* sp, *Eichhornia* sp, *Pistia* sp and *Victoria amazonica.* As the lakes age, the marshes are invaded by shrubs and trees.

e) Paramo. This is the humid grass-shrub association that borders the upper limits of the temperate forests in the Eastern Andes and in the Western Andes between Piura and Cajamarca. In areas free from fires and grazing, grasses such as *Calamagrostris* sp and *Festuca* sp can grow to a considerable height. Shrubs include species of *Brachyotum, Gynoxys, Hesperolemes, Hypericum* and *Senecio*, and bromeliads and ferns are conspicuous. Small lakes are scattered throughout the paramo, and bogs occur in poorly drained areas.

f) Montane lakes, streams and marshes. There are three main types of lakes: shallow to deep glacial lakes and pools with relatively little fringing marsh vegetation; shallow lakes, some very large in size, with fringing marshes of *Typha* sp, *Scirpus* sp, etc; and shallowsaline lakes many of which are seasonal.

g) Mangrove swamps. These occur only on the coast of Tumbes Department, at the southern limit of mangroves on the Pacific coast of South America.

h) Coastal lagoons and marshes. These are scattered along the entire coastline; most are brackish and occur within a few hundred metres of the coast. Dominant aquatic plants include species of *Typha* and *Scirpus.*

i) Coastal beaches and mudflats. Sandy shores characterize much of northern Peru, while rocky and sandy beaches alternate from central Peru to the Chilean border. There are only small areas of tidal mudflats, e.g. in the Bay of Paracas. Stretches of sea cliff and numerous rocky offshore islands provide nesting sites for many sea-birds.

j) Coastal waters. The waters of the Humboldt Current are particularly important for sea-birds, notably the guano-producing Phalacrocoracidae and Sulidae. This cold current moving northward along the Peruvian coast turns out into the Pacific at the latitude of Talara, and warm-water sea-birds are found from there northward.

Institutional Base for Wetland Conservation and Research

The following organizations are concerned with conservation and/or research in Peru:

Instituto Nacional Forestal y de Fauna (INFOR): responsible for the establishment and management of protected areas. The Institute has been conducting research on resident and migratory birds at the Mejia Lagoons, and collaborates on numerous research projects with foreign institutions.

Direccion General Forestal y de Fauna: responsible for hunting legislation and hunting seasons.

Oficina Nacional de Evaluacion de Recursos Naturales (ONERN): responsible for conducting inventories of natural resources including wetlands.

Universidad Nacional Agraria La Molina: the Centro de Datos para la Conservacion (CDC) in the Departamento de Manejo Forestal gathers information on the natural ecosystems of Peru and identifies areas of importance for conservation.

Museo de Historia Natural "Javier Prado": dedicated to the collection of biological specimens and taxonomic studies.

Universidad Nacional Mayor de San Marcos: dedicated to the collection of biological specimens and taxonomic studies.

Asociacion Peruana para la Conservacion (APECO): a private organization dedicated to the conservation of nature.

Progress in Wetland Conservation and Research

The Sistema Nacional de Unidades de Conservacion includes four categories of protected areas: National Parks, National Reserves, National Sanctuaries and Historical Sanctuaries. The protected areas which include significant wetlands are as follows:

Parque Nacional de Huascaran (340,000 ha), established in 1975.
Parque Nacional de Manu (1,532,806 ha), established in 1973, and the Bosque Nacional de Manu (Manu National Forest), established in 1973. Both are included in a Biosphere Reserve (1,881,200 ha), established in 1977.
Reserva Nacional de Junin (52,250 ha), established in 1974.
Reserva Nacional de Pacaya-Samiria (2,080,000 ha), established in 1977.
Reserva Nacional de Paracas (335,000 ha), established in 1975.
Reserva Nacional de Salinas y Aguada Blanca (366,936 ha), established in 1979.
Reserva Nacional de Tambopata (5,500 ha), established in 1977.
Reserva Nacional del Titicaca (36,180 ha), established in 1978.
Zona Reservada de las Lagunas de Mejia (890.6 ha), established in 1982. In 1984, the protected area was reduced to 690.6 ha, and designated as a Santuario Nacional.

Recent and ongoing research projects involving wetlands and/or waterfowl include the following:

a) Various studies at Mejia Lagoons (H. Blokpoel, T. Haig *et al*, R.A. Hughes, INFOR, J.P. Myers, V. Pulido, and US Fish and Wildlife Service).
b) An inventory of lakes and dams in Peru (ONERN).
c) An inventory of mangrove swamps in Peru (ONERN).
d) A study of the ecology and migrations of *Calidris alba* (J. P. Myers *et al*).
e) A study of the ecology and distribution of *Sterna hirundo* (H. Blokpoel *et al*).
f) Avifaunal studies, especially research on Podicipedidae, at various Andean lakes (J. Fjeldsa).
g) Studies of flamingos at Andean lakes (S.H. Hurlbert, T. Moreno *et al*).
h) A variety of studies at Lake Junin by many researchers.
i) Avifaunal studies along the Rio Manu (J. Terborgh, J. Fitzpatrick *et al*).
j) Regular waterfowl censuses at Mejia Lagoons, Paracas National Reserve, Villa Marshes and Laguna El Paraiso (APECO).
k) A complete inventory and evaluation of the diverse natural ecosystems of Peru (CDC).

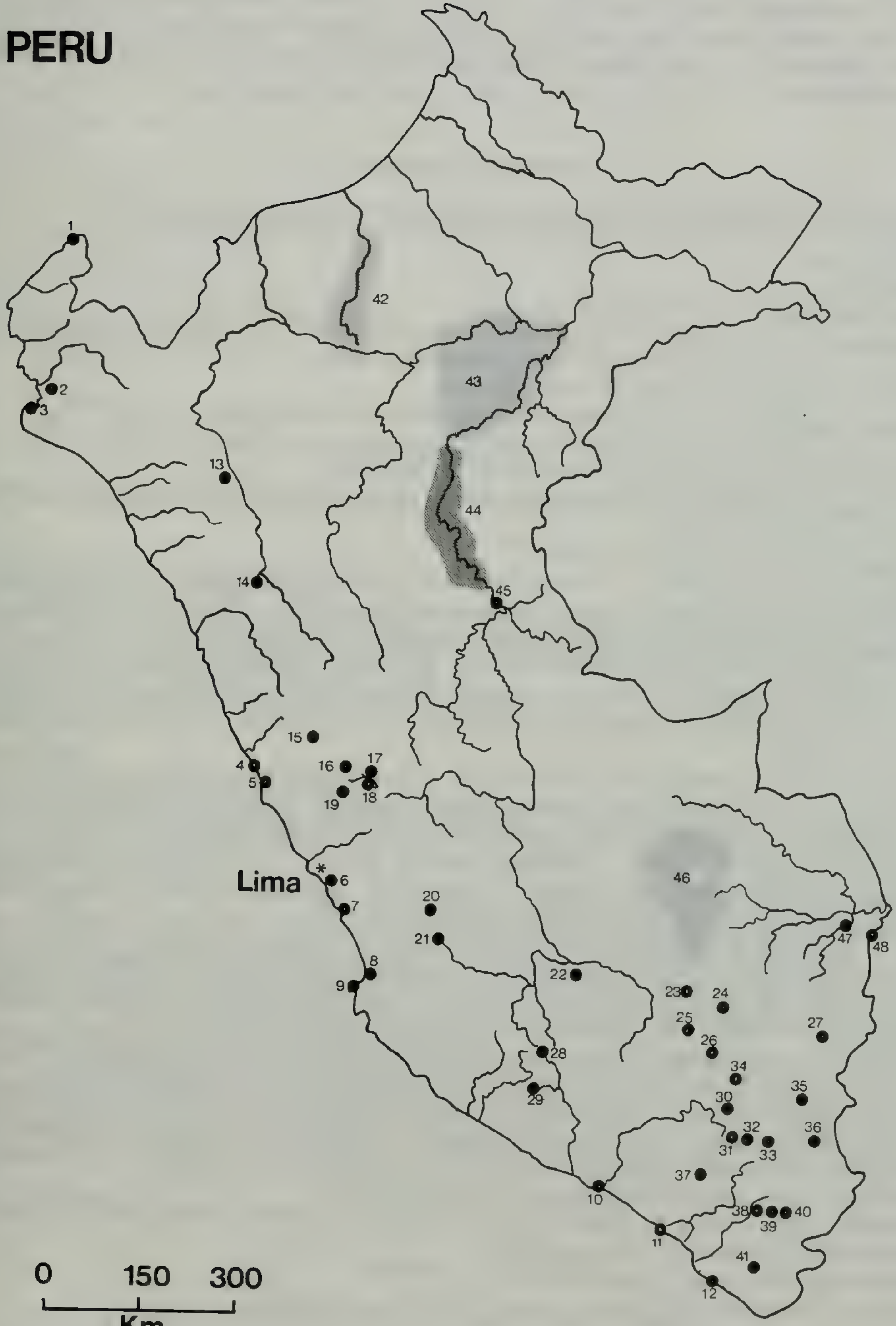
Major Threats to Wetlands and Waterfowl

Threats common to a large number of wetlands in Peru are illegal and uncontrolled hunting, intensive grazing by domestic livestock, excessive felling of timber, and contamination with pesticides and other toxic substances.

It has been calculated that only 34.8% of Peruvian territory is suitable for agricultural purposes, and thus one of the most serious threats to wetlands is drainage for agriculture or diversion of the water supply for irrigation purposes elsewhere. This is the case at Lake Junin where a plan exists to transfer water from the lake to the arid Pacific slope, at the Mejia Lagoons where a proposal has been made to drain one section of the protected area for agricultural land, and at every other coastal wetland. In some wetlands, fisheries projects are being carried out which involve management practices incompatible with the conservation of natural ecosystems and particularly their waterfowl.

Peru

In the interior of Peru, and especially in the high Andes, there is a great risk of contamination from widespread mining activities, while in the forests of the Amazon lowlands, the main threat to many wetlands is disturbance from human activities such as hunting, fishing and the use of motor boats.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WETLANDS

Site descriptions based on the following: data sheets provided by Eric Cardich and Victor Pulido of the Instituto Nacional Forestal, Manuel Rios and colleagues of the Centro de Datos para la Conservacion, Jon Fjeldsa and B. Anthony Luscombe; information provided by Robert A. Hughes, Stuart H. Hurlbert and Tomas Moreno; data extracted from an inventory of lakes and dams prepared by the Oficina Nacional de Evaluacion de Recursos Naturales (ONERN); and the literature.

The Tumbes Mangroves (1)

Location: 3°30'S, 80°25'W; 10 km northeast of Tumbes, Tumbes Department.
Area: 8,044 ha.
Altitude: 0-2m.
Province and type: 8.19.4; 02, 05, 06, 07 & 08.
Site description: The estuarine system of the Rio Tumbes, with extensive mangrove swamps, intertidal mudflats, sandy beaches and some saline flats. This is the southern limit of mangroves on the Pacific coast of South America.
Principal vegetation: The dominant mangroves are *Rhizophora mangle* and *Avicennia germinans*, but there are also some *Laguncularia racemosa* and *Conocarpus erectus*. Also saline flats with halophytic vegetation. In the arid tropical zone.
Land tenure: State owned, with some concessions to private individuals for shrimp farming.
Protection: None at present.
Land use: Fishing and shrimp farming.
Waterfowl: A wide variety of waterfowl occur, including several species which are rare elsewhere in Peru, and many species of Nearctic shorebirds. Characteristic species and local specialities include *Pelecanus occidentalis, Fregata magnificens* (up to 1,000), *Nyctanassa violacea, Butorides striatus, Egretta caerulea, E. tricolor, Eudocimus albus* (up to 40), *Ajaia ajaja, Charadrius collaris, Larus cirrocephalus* and *Gelochelidon nilotica.* About twenty species of Nearctic shorebirds occur regularly, along with *Larus atricilla, L. pipixcan, Chlidonias nigra* and *Sterna hirundo.*
Other fauna: The Osprey *Pandion haliaetus* is a common winter visitor. There are small populations of the otter *Lutra anectens* and American Crocodile *Crocodylus acutus*, both endangered species in Peru. The marine invertebrate fauna is especially rich and forms the basis of an important fishery. Important species include the gastropods *Mytella guyanensis, Anadara tuberculosa* and *A. similia.* Thirty-three species of Gastropoda, 24 species of Pelecipoda and 35 species of Crustacea have been recorded.
Threats: The main threat to the area is the clearing of mangroves to provide space for shrimp farms, and felling for timber. This continues unabated, and over 300 ha were cleared in 1984. Other problems in the area include use of DDT to control mosquitos, excessive exploitation of lobsters and other shellfish, hunting of sea turtles, and tourist development.
Research and conservation: A considerable amount of basic research has been conducted in the area, and a proposal was made in 1981 for the establishment of a protected area of 14,419 ha including all the mangrove areas and the adjacent coastal waters. However, no action has as yet been taken on this. The Oficina Nacional de Evaluacion de Recursos Naturales (ONERN) has recently completed a detailed study of the area and made a variety of recommendations concerning conservation and development in the region.
References: Peña (1970a & 1970b); Pulido & Gutierrez (1982); ONERN & Direccion General ITMITI (1983); Pulido & Yockteng (1983).
Source: Eric Cardich and Victor Pulido.
Criteria for inclusion: 123.

Laguna Ramon Grande and Laguna Ramon Chico (2)

Location: 5°30'S, 80°40'W; 30 km SSW of Piura, Piura Department.
Area: 2,000 ha.
Altitude: 20m.
Province and type: 8.24.7; 14.
Site description: Two temporary saline lagoons in a desert area 20 km from the coast. Extensive flooding occurs at irregular intervals according to local rainfall.
Principal vegetation: A desert region with sparse halophytic vegetation.
Land tenure: State owned.
Protection: None.
Land use: No information.
Waterfowl: Large numbers of waterfowl occur when the lagoons are flooded, as was the case in 1983 following exceptional rainfall associated with "El Niño" of that year.
Other fauna: No information.
Threats: No information.
Source: Centro de Datos para la Conservacion.
Criteria for inclusion: 3b.

Virrila Estuary (3)

Location: 5°50'S, 80°50'W; 75 km SSW of Piura, Piura Department.
Area: 3,370 ha.
Altitude: 0-2m.
Province and type: 8.24.7; 02, 05, 06 & 07.
Site description: A tidal estuary and old arm of the Rio Piura, extending 35 km inland, with tidal mudflats, sandy beaches, coastal sand dunes and brackish marshes. Occasional flooding of the Rio Piura inundates the area with fresh water.
Principal vegetation: Some brackish marshes with *Scirpus* sp.
Land tenure: State owned.
Protection: None.
Land use: Traditional fishing and hunting.
Waterfowl: An important estuary for migratory waterfowl, particularly Nearctic shorebirds and Laridae. A variety of Ardeidae occur, and *Eudocimus albus*, *Ajaia ajaja* and *Phoenicopterus chilensis* have been recorded.
Other fauna: Large numbers of sea-birds occur in the inshore waters of the adjacent bay, and the Osprey *Pandion haliaetus* is a regular winter visitor. Up to 30 *Otaria flavescens* occuron the nearby Punta Agujas, and sea turtles, possibly *Chelonia mydas*, have been reported.
Threats: There is a potential threat of contamination from a nearby oil terminal and from the fishing industry at Parachique, at the mouth of the estuary. There is some illegal hunting of sea-lions, and destruction of birds' nests by fishermen.
Research and conservation: The "Plan Maestro de Manejo Forestal para el Noroeste del Peru" includes a provisional proposal for the establishment of a protected area at the estuary.
References: Peterson (1975); CEPID (1981); Leo *et al* (1981).
Source: Eric Cardich, Victor Pulido, Centro de Datos para la Conservacion and B. Anthony Luscombe.
Criteria for inclusion: 3a.

Laguna de Medio Mundo and Laguna San Felipe (4)

Location: 10°56'S, 77°40'W; 20 km north of Huacho, Lima Department.
Area: L. Medio Mundo 206 ha; L. San Felipe 200 ha.
Altitude: 0-1m.
Province and type: 8.24.7; 05 & 07.

Site description: Two slightly brackish coastal lagoons, up to 2m deep, with associated fresh to brackish marshes, and adjacent sandy beaches. The lagoons receive their water from seepage and run-off from nearby irrigated land. This area is one of only three coastal wetlands remaining in the Department of Lima.
Principal vegetation: Marshes with *Typha angustifolia, Hydrocotyle, Potamogeton, Wolffia, Equisetum, Scirpus, Cyperus, Sesuvium portulacastrum*, various Gramineae, *Salicornia* and many algae.
Land tenure: L. Medio Mundo is state owned; L. San Felipe is privately owned.
Protection: None, but the owner of Laguna San Felipe controls that area effectively.
Land use: Traditional fishing, duck hunting, reed-cutting for a local basket-making industry, livestock grazing and recreation; agriculture in the surrounding areas. Laguna de Medio Mundo was formerly used as a shrimp raising pond.
Waterfowl: A wide variety of species have been recorded including breeding *Podylimbus podiceps, Anas bahamensis* (up to 200) and *Gallinula chloropus* (up to 900), and many wintering Nearctic shorebirds. The commoner shorebirds include *Charadrius semipalmatus, Tringa flavipes, Calidris alba* and *Steganopus tricolor.*
Other fauna: Fishes include *Bryconamericus peruanus, Lebiasina bimaculata, Dormitator latifrons, Mugil cephalus* and *Pygidium punctulatum*; and the iguana *Tropidurus peruvianus* occurs.
Threats: Laguna de Medio Mundo is under serious threat of drainage for agriculture, and the wetland is already being polluted by pesticide run-off from adjacent cultivated land. There is increasing urban development in the area, and considerable disturbance from hunters.
Research and conservation: Laguna de Medio Mundo and its fauna and flora have been described in some detail by Tovar.
References: Dourojeanni *et al* (1969); Tovar (1977); Pulido (1983b).
Source: Eric Cardich, Victor Pulido, Centro de Datos para la Conservacion and B. Anthony Luscombe.
Criteria for inclusion: 2b & 3a.

Laguna Playa Chica and Laguna El Paraiso (5)

Location: 11°12'S, 77°36'W; 10 km south of Huacho, Lima Department.
Area: 4,440 ha.
Altitude: 0-1m.
Province and type: 8.24.7; 05, 07 & 13.
Site description: A complex of shallow brackish coastal lagoons, up to 1.5m deep, and brackish and freshwater marshes situated behind a sea beach. Water levels are influenced by the tides, seepage and run-off of freshwater from nearby irrigated land. Laguna El Paraiso is an artificial wetland, created in 1973 by agricultural run-off.
Principal vegetation: Marshes with *Typha* sp and halophytic vegetation.
Land tenure: A mixture of state and private ownership.
Protection: No habitat protection, but the wetland is in a no hunting zone.
Land use: Traditional, commercial and sport fishing; some pisciculture; illegal hunting; tourist recreation; and grazing of livestock.
Waterfowl: Fifty-five species of waterfowl have been recorded, including 22 Nearctic shorebirds and a wide variety of gulls and terns Laridae. Resident species include *Podilymbus podiceps, Rollandia rolland*, several Ardeidae, *Anas bahamensis* (almost 1,000 present in late 1984), *A. cyanoptera, Rallus sanguinolentus, R. limicola, Fulica americana/ardesiaca, Charadrius vociferus* and *C. alexandrinus. Eudromias ruficollis*is a winter visitor from the Andes.
Other fauna: The Osprey *Pandion haliaetus* and Peregrine Falcon *Falco peregrinus* are regular non-breeding visitors, and a wide variety of Humboldt current sea-birds occur offshore.
Threats: The main threats are pesticide run-off from adjacent irrigated land, and excessive disturbance from illegal and indiscriminate hunting.
Research and conservation: The avifauna has been described in some detail by Castro; the Panamerican Shorebird Program has conducted censuses; and various proposals for the conservation and management of the area have been made.

References: Ministerio de Agricultura (1980a & 1980b); Pulido (1983b); Castro (1984).
Source: Eric Cardich, Victor Pulido, Centro de Datos para la Conservacion, and B. Anthony Luscombe.
Criteria for inclusion: 2b & 3a.

Villa Marshes (6)

Location: 12°13'S, 77°01'W; 20 km south of Lima, Lima Department.
Area: 500 ha.
Altitude: 0m.
Province and type: 8.24.7; 05, 07 & 12.
Site description: A complex of permanent shallow fresh and brackish ponds and marshes, shallow impoundments used for irrigation, and halophytic steppe behind an ocean beach. Water levels fluctuate widely, and are lowest during the dry summer months (December to March).
Principal vegetation: Marshes with *Typha* sp and *Scirpus* sp; and halophytic steppe with scattered palms.
Land tenure: A mixture of public and private ownership.
Protection: None.
Land use: Cattle grazing; reed-cutting for basket-making; recreation, particularly along the beach; and some hunting. There is some irrigated agricultural land and extensive suburban development, including a country club and golf course, nearby.
Waterfowl: Most of the waterfowl typical of the coastal wetlands of Peru have been recorded. Common residents include *Podilymbus podiceps, Rollandia rolland, Ixobrychus exilis, Bubulcus ibis, Butorides striatus, Egretta caerulea, Anas cyanoptera, Rallus sanguinolentus, Gallinula chloropus* and *Charadrius vociferus*. At least 17 Nearctic shorebirds have been recorded, the commoner species including *Charadrius semipalmatus, Numenius phaeopus, Tringa melanoleuca, T. flavipes, Actitis macularia, Calidris alba, C. pusilla, C. mauri, C. minutilla* and *Steganopus tricolor*. *Larus pipixcan* occurs in enormous numbers in the austral summer; *Sterna hirundo* is a common non-breeding visitor; and *Anas discors* has occurred. Wanderers from the high Andeans have included *Anas flavirostris, A. puna* and *Vanellus resplendens*.
Other fauna: There is a small resident population of the Peruvian Thick-knee *Burhinus superciliaris* on the adjacent steppe, and *Pandion haliaetus* and *Falco peregrinus* are regular non-breeding visitors. Humboldt current sea-birds are abundant along the adjacent coast.
Threats: The principal threat is the reclamation of land for housing development and recreation facilities. The marsh is used as a dump for domestic waste; there is some pollution from domestic sewage; and there is excessive disturbance from recreation activities in the surrounding areas.
Research and conservation: Despite intense human activity in the area and proximity to the suburbs of Lima, the area remains rich in wildlife, and many species have in fact benefitted from the construction of ornamental ponds and runoff of waste irrigation water. The marshes and beach are a popular bird-watching area for visitors to Lima; the avifauna is well known, and some bird banding has been carried out. The site has excellent potential for the creation of a small multiple use conservation area with emphasis on nature oriented recreation and education.
Source: B. Anthony Luscombe.
Criteria for inclusion: 3a.

Puerto Viejo Marshes (7)

Location: 12°32'S, 76°45'W; south of Chilca, 70 km south of Lima, Lima Department.
Area: 1,000 ha.
Altitude: 0m.
Province and type: 8.24.7; 05 & 07.

Site description: A complex of shallow saline lagoons and marshes behind a sea beach, and almost encircled by the coastal foothills of the Andes. The water surface is much reduced during the summer months (December to March).
Principal vegetation: *Scirpus* marshes and halophytic steppe.
Land tenure: A mixture of private and public ownership.
Protection: None.
Land use: Cattle grazing; chicken farming; sport hunting; sport fishing; reed-cutting for basket-making; and beach recreation.
Waterfowl: Not well known, but apparently similar to other coastal wetlands of Peru. *Podilymbus podiceps, Rollandia rolland, Anas bahamensis* and *A. cyanoptera* are known to breed, *Anas discors, Oxyura jamaicensis ferruginea* and *Rynchops niger* have occurred as non-breeding visitors, and the very local *Laterallus jamaicensis* has been recorded. A wide variety of Nearctic shorebirds occur on passage and during the austral summer, the commoner species including *Numenius phaeopus, Tringa melanoleuca, T. flavipes* and *Actitis macularia.*
Other fauna: *Burhinus superciliaris* occurs on adjacent steppe; and *Pandion haliaetus* and *Falco peregrinus* occur as non-breeding visitors.
Threats: The wetland is under imminent threat from a development project for holiday homes and beach recreation, and surveying work has already commenced.
Research and conservation: One of the larger coastal wetlands in central Peru and still with large populations of waterfowl. Its proximity to Lima makes it an ideal site for wetland research and conservation education, but unless measures are taken in the near future, the site will be lost to development.
Source: B. Anthony Luscombe.
Criteria for inclusion: 3a.

Agua Santa Marshes (8)

Location: 13°41'S, 76°12'W; north and east of Pisco, Ica Department.
Area: 2,000 ha.
Altitude: 0-150m.
Province and type: 8.24.7; 05, 07, 10, 11 & 13.
Site description: A complex of seasonal ponds and marshes along the lower Rio Pisco from the Andean foothills to the coast, and a group of permanent fresh to brackish lagoons and marshes behind a sea beach near the river mouth. The riverine marshes are flooded from April to December or January; surface water disappears by late summer, but the ground remains boggy.
Principal vegetation: Coastal lagoons with submergent vegetation including *Zanichellia* sp; *Scirpus* marshes; and halophytic steppe.
Land tenure: A mixture of state and private ownership.
Protection: None.
Land use: Grazing of domestic livestock; some sport and subsistence hunting.
Waterfowl: A wide variety of waterfowl typical of coastal Peru have been recorded, particularly in the coastal marshes which provide excellent feeding habitat for Ardeidae and shorebirds. Resident species include *Podilymbus podiceps, Rollandia rolland* (up to 100), *Anas cyanoptera, Laterallus jamaicensis, Gallinula chloropus, Charadrius vociferus* and *C. alexandrinus.* Other regular visitors which may breed include *Egretta caerulea, E. thula, E. alba, Anas georgica* and *Larus cirrocephalus.* Winter visitors from the Andes include *Plegadis ridgwayi* and *Eudromias ruficollis*; common Nearctic migrants include *Pluvialis squatarola, Tringa melanoleuca, T. flavipes, Arenaria interpres, Limnodromus griseus, Calidris alba* and *Larus pipixcan.*
Other fauna: *Falco peregrinus* is a regular non-breeding visitor. The coastal lagoons have exceptionally high populations of crustaceans and small fishes *Mugil* sp.
Threats: There have been several unsuccessful attempts in the past to reclaim the marshes for agriculture, and the threat remains.
Research and conservation: Some studies have been conducted on Nearctic shorebirds, including an analysis of pesticide residues in prey species of *Falco peregrinus.*
Source: Jon Fjeldsa and B. Anthony Luscombe.
Criteria for inclusion: 3a.

Wetlands in Paracas National Reserve (9)

Location: 13°50'S, 76°17'W; 15 km southwest of Pisco, Ica Department.
Area: Area of wetlands unknown; 16 km of shoreline in Paracas Bay.
Altitude: National Reserve 0-786m.
Province and type: 8.24.7; 01, 04, 05 & 06.
Site description: The coast of the Paracas National Reserve is primarily rocky, with high sea cliffs, and boulder and shingle beaches. However, in Paracas Bay there is a large area of tidal mudflats, and long sandy beaches.
Principal vegetation: Marine algae, with beds of *Ulva* spp in Paracas bay; some *Distichlis spicata* and *Sesuvium portulacastrum* close to the sea shore. In a region of true desert, almost devoid of vegetation.
Land tenure: State owned.
Protection: Within the Paracas National Reserve (335,000 ha including 217,500 ha of coastal waters), established in 1975.
Land use: Traditional fishing, collection of marine algae for food and fuel, and tourism.
Waterfowl: One of the richest areas for waterfowl and sea-birds on the Peruvian coast, best known for its sea-bird colonies (on the offshore Ballestas Islands), non-breeding flock of *Phoenicopterus chilensis* (up to 150), and wide variety of Nearctic shorebirds. Residents and local migrants include *Podiceps major, Anas bahamensis, Haematopus palliatus, H. ater, Charadrius vociferus, C. alexandrinus, Larus cirrocephalus* and *Rynchops niger.* Over 20 species of Nearctic shorebirds have occurred: a census in March 1982 included 169 *Pluvialis squatarola*, 354 *Charadrius semipalmatus*, 101 *Tringa flavipes*, 75 *Limnodromus griseus*, 1,228 *Calidris pusilla*, 2,495 *C. mauri* and 1,491 *C. alba*, plus smaller numbers of ten other species. The area is also interesting for the number of vagrants which have been recorded.
Other fauna: The Marine Otter *Lutra felina*, South American Sea-lion *Otaria flavescens* and Southern Fur Seal *Arctocephalus australis* are common; and the sea turtles *Chelonia mydas* and *Dermochelys coriacea* occur. The Osprey *Pandion haliaetus* is a common winter visitor.
Threats: The main threat to the area is pollution from chemical industries and fish factories in towns along the nearby coast. A serious pollution incident occurred in early 1984, and resulted in the death of a large number of marine and shore birds. There is some disturbance from both subsistence and commercial fishing in the Reserve, and the exploitation of salt deposits could pose a threat.
Research and conservation: The fauna and flora have been well studied and documented, and a Master Plan has been prepared for the Reserve (Tovar & Rios, 1979). Ongoing investigations include studies of the flamingos, shorebirds and wintering *Sterna hirundo* population.
References: Koepcke (1964); Grimwood (1967); Koepcke & Koepcke (1968); Ministerio de Agricultura (1971); Rios & Dourojeanni (1972); Rios (1974); Tovar & Rios (1979); IUCN (1982); Myers & McCaffery (1984).
Source: Eric Cardich, Victor Pulido, and Centro de Datos para la Conservacion.
Criteria for inclusion: 123.

Laguna Tilimaco and Laguna Pucchun (10)

Location: 16°37'S, 72°44'W; southwest and west of Camana, Arequipa Department.
Area: 110 ha.
Altitude: 0-1m.
Province and type: 8.24.7; 05, 07 & 13.
Site description: A complex of brackish lagoons and marshes, and freshwater marshes behind a sea beach. Until the mid 1970s, this was the largest coastal wetland system in southern Peru, but major drainage schemes for agriculture have greatly reduced the extent of natural wetland habitat and this is now very fragmented.
Principal vegetation: Marshes with *Typha* sp; grassland with *Distichlis* sp; and sand dune vegetation.
Land tenure: Privately owned.
Protection: None.
Land use: Agriculture including rice growing, reed-cutting, livestock grazing and hunting. Formerly one of the most important duck hunting areas in coastal Peru.

Waterfowl: Formerly even more important for waterfowl than the Mejia Lagoons to the south, but with the destruction of a large part of the wetland habitat in the late 1970s, the number of birds using the area has fallen considerably. Even so, a wide variety of species was observed during a brief survey of one part of the marshes in April 1984, and clearly the area is still of considerable importance. Observations included *25 Rollandia rolland, 100 Egretta thula, 40 Egretta caerulea, 30 Egretta tricolor, 1,000 Anas cyanoptera, 150 A. bahamensis, 75 A. georgica, 1,000 Gallinula chloropus, 150 Tringa flavipes, 6 Larus cirrocephalus* and thousands of *L. pipixcan.*
Other fauna: No information.
Threats: Drainage of the remaining wetland habitat presumably continues.
Research and conservation: There is an urgent need for a complete survey of the area to determine the importance of the remaining wetland habitat and the possibilities for protection.
Source: Centro de Datos para la Conservacion and R.A. Hughes.
Criteria for inclusion: 2b.

Lagunas de Mejia (11)

Location: 17°09'S, 71°50'W; 20 km southeast of Mollendo, Arequipa Department.
Area: 1,000 ha.
Altitude: 0-3.5m.
Province and type: 8.24.7; 05, 07 & 13.
Site description: A complex of brackish lagoons and marshes behind a sea beach, with nearby small freshwater ponds and marshes fed by springs. The lagoons receive their water from the Rio Tambo, from seepage of sea water, and from run-off from nearby irrigated land. The average depth is under a metre; the maximum about 3m. It seems that there has always been some wetland habitat in this area, but in the 1940s, the diversion of water from the Rio Tambo for irrigation purposes and the ensuing run-off resulted in a great increase in the size of the lagoons. However, plans to drain the area for agriculture were implemented at the end of the 1970s, and by late 1981, the main lagoons were completely dry. The spring-fed marshes along the base of the escarpment to the north remained unaffected by this drainage. The public outcry following the drainage led to the establishment of a reserve in January 1982, and the successful reflooding of the area. The heavy rains associated with "El Nino" in 1983 brought water levels back to normal and even higher.
Principal vegetation: Marshes with *Scirpus americanus, Typha angustifolia, Salicornia fruticosa, Potamogeton* sp, *Hydrocotyle bonariensis, Equisetum bogotense* and algae of the genera *Chara, Enteromorpha, Spyrogira* and *Chlorella*; grassy areas with *Paspalum* sp, *Distichlis spicata* and *Pennisetum* sp.
Land tenure: State owned.
Protection: A reserve of 890.6 ha was established in January 1982; in 1984, this was decreased in size to 690.6 ha, and upgraded to a National Sanctuary. The Sanctuary includes the main lagoons, but does not include the important spring-fed marshes to the north, or the extensive sand beach to the south of the Rio Tambo.
Land use: Grazing of domestic livestock; shrimp fishing in the lagoons; illegal hunting; and agriculture in surrounding areas.
Waterfowl: The Mejia Lagoons constitute the most significant area of wetland habitat along more than 1,000 km of coast in southern Peru and northern Chile. As such, they are of great importance as a migration staging area for a wide variety of migratory waterfowl. In addition, the lagoons are an important breeding area for many species, some of which reach the southern extremity of their Pacific coastal range at Mejia, while one, *Fulica rufifrons*, reaches its northern limit there. The area is also interesting for the variety of high Andean species which has occurred, particularly in years of drought on the altiplano. Even the flightless Giant Coot *Fulica gigantea* has appeared. Over 85 species of waterfowl have been recorded, including 39 species of shorebirds. Peak counts in recent years have included *300 Egretta thula, 90 E. caerulea, 340 Bubulcus ibis, 200 Phoenicopterus chilensis, several thousand Anas bahamensis, 1,000 A. georgica*, several thousand *A. cyanoptera, 10,000 Gallinula chloropus, 5,000 Fulica americana/ardesiaca, 600 Pluvialis squatarola, 1,000 Calidris bairdii, 3,000 C. alba, 560 Micropalama himantopus, 3,000 Steganopus tricolor*, many thousands of *Larus pipixcan* and 550 *Sterna hirundo.* The adjacent beach system, which extends for 25 km to the south, is also

extremely important for migratory shorebirds, and supports one of the highest densities of *Calidris alba* hitherto discovered.

Other fauna: *Pandion haliaetus* and *Falco peregrinus* are regular winter visitors. The adjacent coastal waters are important for feeding sea-birds.

Threats: Drainage and reclamation for agriculture continue in surrounding areas, and the pumping of water from the main drainage canal has significantly increased seepage rates from the northern lagoon. There is heavy overgrazing in the area and some pollution from pesticides. Hunting, although now illegal, is on the increase, and reed-cutting causes considerable disturbance to nesting birds.

Research and conservation: The avifauna of the lagoons is very well known; Hughes has made regular observations since 1953, and a large number of ornithologists and bird-watchers have visited the area since 1980. Ongoing investigations include studies on the Nearctic shorebirds, particularly *Calidris alba*, and wintering *Sterna hirundo*. Several general studies have been conducted, and a variety of proposals for the management and development of the reserve have been produced.

References: Hughes (1970, 1976, 1979, 1980 & 1984); Tallman *et al* (1978); Arellano *et al* (1980); Pulido & Gutierrez (1980); Myers (1982a & 1982b); Pulido (1982a, 1983a, 1983b, in press-a & in press-b); Commission on Ecology (1983); Haig *et al* (1983).

Source: Eric Cardich, Victor Pulido, Centro de Datos para la Conservacion, and R. A. Hughes.

Criteria for inclusion: 123.

Ite Lagoons (12)

Location: 17°54'S, 70°58'W; 45 km southeast of Ilo, Tacna Department.

Area: c.500 ha.

Altitude: 0m

Province and type: 8.24.7; 05 & 07.

Site description: A complex of shallow saline lagoons and marshes interconnected by narrow channels, behind a sea beach near the mouth of the small Locumba River. This is the last significant lagoonal system for 800 km from southern Peru to north-central Chile.

Principal vegetation: Marshes of *Scirpus* sp with a little *Typha* sp. Irrigated cultivation nearby.

Land tenure: No information.

Protection: None.

Land use: No information.

Waterfowl: A variety of waterfowl typical of coastal Peru were recorded during brief surveys in December 1982 and July 1984, including 50 *Egretta thula*, 200 *Anas bahamensis*, 1,000 *A. cyanoptera*, 3,000 *Gallinula chloropus*, and small numbers of eight species of Nearctic shorebirds.

Other fauna: No information.

Threats: There is serious pollution from waste from nearby copper mines.

Source: R. A. Hughes.

Criteria for inclusion: 2b.

Crisnejas Lakes (13)

Location: 6°41'-6°59'S, 78°18'-78°30'W; 20-50 km NNE of Cajamarca, Cajamarca Department.

Area: 9,000 ha.

Altitude: 3,580-4,060m.

Province and type: 8.37.12; 12 & 19.

Site description: About 45 small freshwater Andean lakes, including Mamacocha, Mishacocha, Lucmacocha and Alforja Cocha, and surrounding Andean bogs, in the upper basins of the Llaucano, Marañon and Crisnejas Rivers, mainly above 3,850m. The lakes vary in size from 1-20 ha. One of the few significant lacustrine systems in the northern Andes of Peru.

Principal vegetation: No information.

Land tenure: No information.

Protection: None.

Land use: No information.
Waterfowl: No information.
Other fauna: No information.
Threats: No information.
References: ONERN (1980).
Source: Centro de Datos para la Conservacion.
Criteria for inclusion: 0.

Laguna Pelagatos and the Conchucos Lakes (14)

Location: 8°05'-8°29'S, 77°40'-78°00'W; 10-30 km east and northeast of Cabana, Ancash Department.
Area: c.7,500 ha of lakes in a region of 50,000 ha.
Altitude: 3,500-4,660m.
Province and type: 8.36.12; 12 & 19.
Site description: About 150 small freshwater Andean lakes and surrounding areas of bog, mainly above 4,000m, in the upper watersheds of the Rio Santa (Pacific slope) and Rio Marañon (Atlantic slope). Laguna Pelagatos (200 ha), to the north of the main group of lakes, is the largest; most of the others are between 5 and 80 ha in extent. The largest lacustrine system in the high Andes of northern Peru.
Principal vegetation: No information.
Land tenure: No information.
Protection: None.
Land use: No information.
Waterfowl: No information.
Other fauna: No information.
Threats: No information.
References: ONERN (1980).
Source: Centro de Datos para la Conservacion.
Criteria for inclusion: 0.

Laguna Lauricocha, Laguna Conococha and lakes in the Cordillera Huayhuash (15)

Location: 10°00'-10°35'S, 76°40'-77°17'W; 60 km northwest of Cerro de Pasco, Departments of Huanuco, Lima and Ancash.
Area: c.10,000 ha.
Altitude: 3,845-4,970m.
Province and type: 8.36.12; 12 & 19.
Site description: Approximately 200 small freshwater lakes and associated bogs in the high Andes of the Cordillera Huayhuash and Cordillera Raura, in the upper watersheds of the Pativilca, Huaura, Marañon and Huallaga Rivers. Laguna Lauricocha (650 ha, 3,845m) and Laguna Conococha (180 ha, 3,990m) are the largest, and also the lowest in elevation. The majority are between 10 and 150 ha in extent, and over 4,400m in elevation.
Principal vegetation: No information.
Land tenure: No information.
Protection: None.
Land use: Grazing of domestic livestock, and some hunting.
Waterfowl: Thousands of waterfowl have been observed at Laguna Conococha, including several species at the northern limit of their distribution in the Andes (T.A. Parker III, pers. com.). Particularly noteworthy are several hundred *Fulica gigantea* and significant populations of *Chloephaga melanoptera* and *Lophonetta specularioides*. Other common breeding birds include *Rollandia rolland, Podiceps occipitalis, Anas georgica* and *A. puna*. No informationis available on the other wetlands.
Other fauna: No information.
Threats: Laguna Conococha is being increased in size with the construction of a dam.

References: ONERN (1980).
Source: Centro de Datos para la Conservacion and Jon Fjeldsa.
Criteria for inclusion: 2b & 3a.

Laguna Acucocha, Laguna Punrun and nearby lakes (16)

Location: 10°40'-11°00'S, 76°24'-76°40'W; in the Andes west of Cerro de Pasco, Departments of Pasco and Lima.
Area: c.10,000 ha, including L. Acucocha (600 ha) and L. Punrun (2,000 ha).
Altitude: 4,300-4,700m.
Province and type: 8.36.12; 12 & 19.
Site description: Some 200 freshwater lakes and associated bogs in the high Andes to the northwest of Lake Junin. Laguna Punrun (2,000 ha) and L. Acucocha (600 ha) are much the largest; the others are mainly bewteen 10 and 70 ha in extent.
Principal vegetation: At Laguna Punrun, there are beds of submergent *Myriophyllum* sp and *Chara* sp, with some *Potamogeton strictus*.
Land tenure: No information.
Protection: None.
Land use: No information.
Waterfowl: Only L. Punrun seems to have been surveyed. This appears to be mainly a staging area for waterfowl during the dry season, when birds are forced to leave the smaller lakes in the area. In October 1977, Fjeldsa observed a variety of high Andean species including 130 *Rollandia rolland*, 37 *Plegadis ridgwayi*, 70 *Chloephaga melanoptera*,80 *Lophonetta specularioides*, 400 *Fulica americana/ardesiaca*, 13 *F. gigantea* (nesting), and a large number of Nearctic shorebirds of the genus *Calidris*.
Other fauna: No information.
Threats: No information.
References: ONERN (1980).
Source: Jon Fjeldsa.
Criteria for inclusion: 0.

Laguna Chacaycancha and Laguna Cutaycocha (17)

Location: 10°51'S, 76°03'W; north of Carhuamayo, near the north shore of Lake Junin, Junin Department.
Area: 400 ha.
Altitude: 4,330m.
Province and type: 8.36.12; 12.
Site description: Two permanent freshwater lakes, Chacaycancha (230 ha) and Cutaycocha (150 ha), on the puna, with extensive shallows and abundant aquatic vegetation. During the wet season, the marshes between the two lakes flood, creating a single wetland of 400 ha.
Principal vegetation: Extensive beds of submergent *Chara* sp, with some *Myriophyllum* sp; shallow marshes with *Juncus* sp and tall tussocks of *Deschampsia* sp.
Land tenure: No information.
Protection: None.
Land use: Very little disturbance; only a few families live near the lakes.
Waterfowl: In November 1983 and February 1985, Fjeldsa observed a variety of Andean waterfowl including breeding *Nycticorax nycticorax, Fulica gigantea* (10-15 pairs), and *Larus serranus*.
Other fauna: Fishes of the genus *Orestias* are plentiful, and the giant amphibian *Batrachophrynus macrostomus*, endemic to the Junin basin, is common.
Threats: None apparent.
Research and conservation: The lakes, although small, appear suitable for the establishment of a second population of the flightless Puna Grebe *Podiceps taczanowskii*. A programme of introduction was initiated by Fjeldsa in February 1985 with the translocation of four grebes from Lake Junin to Laguna Chacaycancha.

Source: Jon Fjeldsa.
Criteria for inclusion: 2b.

Lake Junin (18)

Location: 10°51'-11°11'S, 76°00'-76°15'W; northwest of Junin, Junin Department.
Area: Lake and marshes 29,945 ha; seasonally flooded grassland 10,000 ha.
Altitude: 4,080m.
Province and type: 8.36.12; 12, 13, & 16.
Site description: A large permanent freshwater lake, up to 12.7m deep, fed by 12 rivers and 20 streams; several nearby small lakes and ponds; extensive freshwater marshes; and up to 10,000 ha of seasonally flooded puna grassland. Because of regulation for hydroelectric power, the lake level has fluctuated by 2m or more in recent years; at high levels the area of open water is about 14,500 ha, and there are fringing beds of emergent vegetation up to 6 km wide.
Principal vegetation: Submergent vegetation including *Spyrogira* sp, *Chara fragilia*, *Potamogeton* spp, *Myriophyllum elatinoides*, *Elodea potamoyeto* and *Utricularia* sp; floating vegetation including *Spirodella* sp, *Azolla filiculoides* and *Lemna* sp; emergent vegetation including *Scirpus californicus*, *Juncus andecolus*, *Hydrocotyle bonariensis*, *Rumex peruanus*, and species of *Carex* and *Polygonum*; and seasonally flooded grassland with *Eleocharis* sp, *Calamagrostis rigescens* and *Distichia muscoides*.
Land tenure: State owned.
Protection: Within the Junin National Reserve (52,250 ha) established in 1974.
Land use: Traditional fishing; reed-cutting for animal feed and handicrafts; heavy grazing of wet pastureland by sheep, cattle and llamas; illegal hunting and collection of birds' eggs for human consumption; and generation of hydroelectricity at a dam in the extreme northwest of the lake. Some 6,000 people live in small villages around the lake. Large areas of the marshes are regularly burned to improve the grazing.
Waterfowl: An extremely important area for both breeding and wintering waterfowl; very well known and well documented. The lake has an endemic grebe *Podiceps taczanowskii* and the marshes are the only known locality for the recently described subspecies of the Black Rail *Laterallus jamaicensis tuerosi*. A number of complete censuses of the waterfowl have been attempted; censuses in 1977-1979 suggested populations of about 300 *Podiceps taczanowskii*, 3,500-4,000 *Rollandia rolland*, several hundred *Nycticorax nycticorax*, 8,000 *Plegadis ridgwayi*, 8,000-10,000 *Anas flavirostris*, up to 50,000 *A. puna*, 6,000 *A. georgica*, 2,000-3,000 *Oxyura jamaicensis ferruginea*, thousands of *Rallus sanguinolentus*, at least 50,000 *Gallinula chloropus*, 15,000 *Fulica americana/ardesiaca* and 3,000 *Larus serranus*. *Phoenicopterus chilensis* nested in the mid 1970s and again in 1984, but in most years only non-breeders are present (up to 5,000). Up to 1,000 *Chloephaga melanoptera* occur as non-breeding visitors during the dry season. *Anas discors* is a regular visitor in small numbers, and twelve species of Nearctic shorebirds have been recorded. Of these, the most abundant are *Pluvialis dominica*, *Tringa melanoleuca*, *T. flavipes*, *Calidris bairdii* and *Steganopus tricolor*, which occurs in tens of thousands in the northern winter. The waterfowl surveys have been summarized by Harris (1981) and Fjeldsa (1983b). Observations by Fjeldsa in October 1983 and February 1985 suggest that the combination of drought and increased use of water for hydroelectric power has resulted in mass starvation of *Rollandia rolland* and a considerable reduction in numbers of Anatidae, *Fulica americana/ardesiaca* and possibly also *Podiceps taczanowskii*.
Other fauna: There is an abundant fish population in the lake, including *Salmo gairdnieri*, *Pygidium oroyae*, *Orestias elegans*, *O. agasii*, *O. empyraeus* and *Astroblepus praeolierum*. Amphibians include *Batrachophrynus macrostomus*, *B. brachydactylus*, *Gastrotheca peruana*, *Pleurodema marmorata* and *Bufo spinulosus*. *Vicugna vicugna*, *Odocoileus virginianus* and *Hippocamelus antisensis* occur in the area.
Threats: The most important threats to the lake system are pollution from mining activities in the surrounding hills, and a proposed scheme to raise the level of the lake to divert water to the Pacific slope and provide an additional water supply for Lima (the Mantaro Water Transfer Project). Present plans involve cutting off the polluted Rio San Juan and increasing the level of the lake, which may be disastrous for cattle ranching in the area but could improve conditions for the endemic *Podiceps taczanowskii*. Since Lake Junin would have a small

catchment area without the Rio San Juan, it is unclear whether the high water level could be maintained. The grasslands around the lake are heavily overgrazed by domestic livestock, but this may be harmful to only a few species and is a prerequisite for the maintenance of shorebird habitat. Other disturbances include the burning of marsh vegetation, reed-cutting, waterfowl hunting and the collection of birds' eggs, but these are not thought to have any very harmful effects. About 700 people are involved in hunting and egg-collecting.

Research and conservation: Lake Junin has been well studied and documented. Recent work has concentrated on the ecological impact of the Mantaro Water Transfer Project, and on the possibility of establishing a second population of *Podiceps taczanowskii* on nearby lakes (Laguna Chacaycancha and Laguna Cutaycocha, site 17).

References: Morrison (1939); Ortiz de la Puente (1952); Gill (1964); Dourojeanni *et al* (1968); Binnie & Partners (1975); Petterson (1977); Harris (1980, 1981 & 1982); Fjeldsa (1981b, 1981d, 1982a, 1983a, 1983b, 1983c & undated); Tovar & Rios (1981 & 1982); Chuquichaico (1982); IUCN (1982); Pulido (1983b).

Source: Eric Cardich, Victor Pulido, Centro de Datos para la Conservacion and Jon Fjeldsa.

Criteria for inclusion: 123.

Marcapomacocha Lakes (19)

Location: 11°00'-11°26'S, 76°17'-76°30'W; in the high Andes southwest of Lake Junin, Departments of Pasco and Junin.

Area: c.10,000 ha.

Altitude: 4,300-4,700m.

Province and type: 8.36.12; 12 & 19.

Site description: About 175 small to medium sized freshwater lakes in the high Andes, with associated marshes, numerous small rivers and streams, and Andean bogs; mainly at elevations between 4,400 and 4,600m. Some of the lakes are shallow, with abundant aquatic vegetation; others are deep oligotrophic lakes of glacial origin. The largest lakes are Laguna Marcapomacocha (440 ha), L. Huaroncocha (1,000 ha), L. Yanamachay, L. Lacsacocha, L. Quimacocha, L. Naticocha, L. Shegui and L. Trapiche. The shallow lakes show marked seasonal fluctuations in water level.

Principal vegetation: Many of the lakes have beds of *Myriophyllum* sp and *Chara* sp; locally there is some *Potamogeton illinoiensis*. *Distichia* sp dominates in the mountain bogs.

Land tenure: No information.

Protection: None.

Land use: The waters of some of the lakes are utilized in mining activities, and there is some grazing of domestic livestock and hunting in the area.

Waterfowl: An important breeding area for *Chloephaga melanoptera, Lophonetta specularioides* and *Fulica gigantea*; 130 of the latter were found at L. Marcapomacocha in November 1983, and 140 in the L. Huaroncocha/L. Shegui area in October 1977. *Podiceps occipitalis, Oxyura jamaicensis ferruginea* and *Fulica americana/ardesiaca* are common on some lakes. The rare Diademed Sandpiper-Plover *Phegornis mitchellii* occurs on bogs at high elevations.

Other fauna: No information.

Threats: Excessive hunting and manipulation of water levels may pose a threat at some lakes.

References: ONERN (1980); Fjeldsa (1981d).

Source: Jon Fjeldsa and Derek A. Scott.

Criteria for inclusion: 2b & 3a.

The Huarmicocha Lake System (20)

Location: 12°32'-12°50'S, 75°24'-75°35'W; 70 km southeast of Huancayo, Departments of Lima, Junin and Huancavelica.

Area: 5,120 ha of lakes.

Altitude: 4,450-4,770m.

Province and type: 8.36.12; 12 & 19.

Site description: A group of about 50 small freshwater lakes and associated streams and bogs in the high Andes. The principal lakes are Laguna Huarmicocha (340 ha), L. Huichicocha (860 ha), L. Acchicocha (320 ha) and L. Chuncho (420 ha).
Principal vegetation: No information.
Land tenure: No information.
Protection: None.
Land use: No information.
Waterfowl: No information.
Other fauna: No information.
Threats: No information.
References: ONERN (1980).
Source: Centro de Datos para la Conservacion.
Criteria for inclusion: 0.

The Orcococha and Choclococha Lake System (21)

Location: 13°05'-13°27'S, 75°02'-75°17'W; 95 km west of Ayacucho, Huancavelica Department.
Area: c.8,000 ha of lakes.
Altitude: 4,450-4,900m.
Province and type: 8.36.12; 12 & 19.
Site description: A group of about 80 small to medium-sized freshwater lakes, and associated streams and bogs in the high Andes, mainly above 4,500m. The principal lakes are Laguna Agnococha (430 ha), L. San Francisco (300 ha), L. Orcococha (1,500 ha), L. Choclococha (1,540 ha) and L. Caracocha (380 ha).
Principal vegetation: No information.
Land tenure: No information.
Protection: None.
Land use: Livestock grazing.
Waterfowl: No information.
Other fauna: No information.
Threats: Pollution from nearby mining activities and manipulation of water levels by damming are affecting some lakes.
References: ONERN (1980).
Source: Centro de Datos para la Conservacion.
Criteria for inclusion: 0.

Laguna Pacucha and the Pachachaca Lakes (22)

Location: 13°36'-13°55'S, 73°05'-73°20'W; 40 km west of Abancay, Apurimac Department.
Area: Laguna Pacucha 768 ha; Pachachaca Lakes in an upland area of 40,000 ha.
Altitude: L. Pacucha at 3,100m; Pachachaca Lakes at c.4,300m.
Province and type: 8.36.12; 12 & 19.
Site description: Laguna Pacucha is a freshwater lake surrounded by agricultural land in an inter-Andean valley. The Pachachaca Lakes are a group of some 150 freshwater lakes (up to 100 ha in extent) with associated bogs on a high plateau of 40,000 ha, about 20 km southeast of L. Pacucha.
Principal vegetation: No information.
Land tenure: No information.
Protection: None.
Land use: Fishing, livestock grazing and agriculture around L. Pacucha.
Waterfowl: No information.
Other fauna: No information.
Threats: There is a considerable amount of human disturbance around L. Pacucha.
References: ONERN (1980).
Source: Centro de Datos para la Conservacion.
Criteria for inclusion: 0.

Huacarpay Lakes (23)

Location: 13°37'S, 71°44'W; 28 km ESE of Cusco, Cusco Department.
Area: 500 ha.
Altitude: 3,170m.
Province and type: 8.36.12; 12.
Site description: Three small freshwater lakes with extensive interconnecting marshes in the valley of the upper Rio Vilcanota. The wetland has a variety of aquatic habitats including a relatively deep open water lake, shallow lakes and ponds with abundant emergent vegetation and muddy areas, extensive reed beds, and wet grassland.
Principal vegetation: Abundant submergent aquatic vegetation, and extensive marshes of *Typha* sp and *Scirpus* sp. In a region of cultivated plains and arid stony hillsides with some thorn scrub.
Land tenure: Privately owned.
Protection: None.
Land use: Grazing by domestic livestock, reed-cutting, sport fishing and recreation. There is a small country club on the shore of one lake.
Waterfowl: The varied wetland habitats support a wide variety of Andean waterfowl and Nearctic shorebirds. The commoner species include *Rollandia rolland, Plegadis ridgwayi, Anas puna, A. cyanoptera, Oxyura jamaicensis· ferruginea, Gallinula chloropus, Fulica americana/ardesiaca* and *Vanellus resplendens.* The Torrent Duck *Merganetta armata* is common on the nearby Rio Vilcanota.
Other fauna: The area has a very rich passerine fauna.
Threats: Disturbance from water sports at the weekends.
Research and conservation: The area possesses a variety of Andean wetland ecosystems and abundant wildlife, and is only 30 minutes by paved road from Cusco city. It is a favourite bird-watching locality for visitors to Cusco, and would provide an ideal site for a wildlife sanctuary and conservation education centre.
Source: Jon Fjeldsa, R. A. Hughes and Derek A. Scott.
Criteria for inclusion: 3a.

Laguna Sibinacocha (24)

Location: 13°55'S, 71°01'W; 110 km ESE of Cusco, Cusco Department.
Area: 2,494 ha.
Altitude: 4,865m.
Province and type: 8.36.12; 12 & 14.
Site description: A high Andean lake of unknown salinity, with many ponds, bogs and mountain streams in the vicinity.
Principal vegetation: No information.
Land tenure: No information.
Protection: None.
Land use: No information.
Waterfowl: No information.
Other fauna: No information.
Threats: No information.
References: ONERN (1980).
Source: Centro de Datos para la Conservacion.
Criteria for inclusion: 0.

Pomacanchi, Asnacocha and Pampa Marca Lakes (25)

Location: 14°00'-14°08'S, 71°27'-71°33'W; 75 km southeast of Cusco, Cusco Department.
Area: 3,400 ha.
Altitude: 3,660-3,785m.
Province and type: 8.36.12; 12.
Site description: A group of four fresh to slightly brackish lakes, Laguna Pomacanchi (2,220 ha), L. Asnacocha (310 ha), L. Pampa Marca (780 ha) and L. Acopia (70 ha), in a cultivated Andean valley in the upper drainage of the Rio Vilcanota. The lakes are relatively deep, and subject to wide fluctuations in water level.
Principal vegetation: Beds of submergent *Chara*, *Potamogeton* and *Myriophyllum*; and marshes with *Scirpus* and *Juncus*.
Land tenure: No information.
Protection: None.
Land use: Livestock grazing and agriculture in the surrounding areas.
Waterfowl: An important area for waterfowl, particularly as a refuge in the dry season when the smaller lakes in the area dry out. Large numbers of birds were present in December 1983, including over 3,500 *Rollandia rolland*, 175 *Podiceps occipitalis*, 210 *Phoenicopterus chilensis*, 530 *Anas puna*, 310 *Oxyura jamaicensis ferruginea* and 8,500 *Fulica americana/ardesiaca*. A few *Fulica gigantea* were also present.
Other fauna: Fishes include *Orestias* spp, *Salmo gairdnieri* and *Basilichthys bonariensis*.
Threats: The Ministry of Agriculture has plans to raise the water level in L. Pampa Marca to avoid drought in adjacent agricultural land. There is heavy overgrazing of the reed beds at L. Pomacanchi, and a potential threat of pollution from domestic sewage at L. Acopia.
References: Hurlbert (1978); ONERN (1980).
Source: Centro de Datos para la Conservacion and Jon Fjeldsa.
Criteria for inclusion: 2b.

Laguna Languilayo (26)

Location: 14°26'S, 71°17'W; 130 km southeast of Cusco, Cusco Department.
Area: 5,408 ha.
Altitude: 3,960m.
Province and type: 8.36.12; 12.
Site description: A large freshwater lake with extensive marshes to the northeast, in a cultivated Andean valley in the upper drainage of the Rio Vilcanota.
Principal vegetation: No information.
Land tenure: No information.
Protection: None.
Land use: Livestock grazing and agriculture in the surrounding areas.
Waterfowl: No information.
Other fauna: No information.
Threats: No information.
References: ONERN (1980).
Source: Centro de Datos para la Conservacion.
Criteria for inclusion: 0.

Laguna Sallahu (Saracucho) (27)

Location: 14°31'S, 69°36'W; between Putina and Cuyocuyo, Puno Department.
Area: A few hundred ha.
Altitude: 4,380m.
Province and type: 8.36.12; 12.
Site description: A freshwater lake and associated marshes in the high Andes, subject to some seasonal fluctuations in water level.
Principal vegetation: Submergent beds of *Myriophyllum* and *Chara*.

Land tenure: No information.
Protection: None.
Land use: Some sheep grazing in the area.
Waterfowl: An important breeding area for the Giant Coot *Fulica gigantea*; 50 individuals were observed in December 1983. Other breeding species include *Podiceps occipitalis, Lophonetta specularioides* and *Oxyura jamaicensis ferruginea.*
Other fauna: No information.
Threats: No information.
Source: Jon Fjeldsa.
Criteria for inclusion: 3a.

The Yaurihuiri Lakes (28)

Location: 14°31'-14°42'S, 73°31'-73°58'W; 25 km east of Puquio, Ayacucho Department.
Area: 3,200 ha of lakes in an area of 6,500 ha.
Altitude: 4,350-4,500m.
Province and type: 8.36.12; 12 & 19.
Site description: A group of about 25 small freshwater lakes and associated bogs in the high Andes. The principal lakes are Laguna Yaurihuiri (780 ha), L. Parccococha (340 ha), L. Sahuaccocha (280 ha) and L. Apinaccocha (460 ha).
Principal vegetation: No information.
Land tenure: No information.
Protection: None.
Land use: No information.
Waterfowl: Laguna Yaurihuiri is the most northerly breeding locality of *Phoenicopterus chilensis* known. The entire area is very important for breeding waterfowl, the commoner species including *Rollandia rolland, Podiceps occipitalis, Chloephaga melanoptera, Lophonetta specularioides, Anas flavirostris, A. puna, A. georgica, Oxyura jamaicensis ferruginea, Gallinula chloropus, Fulica americana/ardesiaca* and *F. gigantea.*
Other fauna: *Vicugna vicugna* and *Hippocamelus antisensis* occur in the area.
Threats: Several main roads traverse the area, and some of the lakes have been dammed.
References: ONERN (1980).
Source: Centro de Datos para la Conservacion.
Criteria for inclusion: 2b.

Lago de Parinacochas (29)

Location: 15°17'S, 73°42'W; between Pullo and Incuyo, Ayacucho Department.
Area: 6,700 ha.
Altitude: 3,273m.
Province and type: 8.37.12; 14.
Site description: A large shallow brackish lake and marshes in a closed basin in the western Andes. At low water levels, wide expanses of salt-encrusted mud are exposed. The salinity is 5.6 p.p.t.
Principal vegetation: Beds of submergent and floating vegetation including *Potamogeton* sp and *Enteromorpha* sp; marshes with *Typha* sp. In a region of dry puna grassland.
Land tenure: State owned.
Protection: None.
Land use: Traditional fishing, hunting, reed-cutting, and livestock grazing. There is some agriculture nearby.
Waterfowl: A very important lake for flamingos and Anatidae. Up to 4,500 *Phoenicopterus chilensis* occur as non-breeding visitors, and *Phoenicoparrus andinus* and *P. jamesi* have been recorded in small numbers. The duck population has been estimated at over 10,000, mainly *Lophonetta specularioides, Anas flavirostris* and *A. puna.* Other common species

include *Rollandia rolland*, *Podiceps occipitalis*, *Plegadis ridgwayi*, *Chloephaga melanoptera* and *Fulica gigantea*. At 3,273m, Parinacochas is the lowest known breeding site for *F. gigantea*.
Other fauna: Apparently there are no fish in the lake, but there is a rich invertebrate fauna. The Vicuna *Vicugna vicugna* and Guanaco *Lama guanacoi* occur in the area.
Threats: Excessive hunting is reported to be a problem.
Research and conservation: The establishment of a protected area was suggested in the 1950s when the area was first surveyed. However, except for a few censuses of flamingos, little work has been carried out since then, and a further survey is clearly required.
References: Koepcke & Koepcke (1952); Hurlbert (1978 & 1982); Hurlbert & Keith (1979).
Source: Eric Cardich, Victor Pulido and Centro de Datos para la Conservacion.
Criteria for inclusion: 123.

Laguna Ananta (30)

Location: 15°22'S, 70°51'W; 100 km northwest of Puno, Puno Department.
Area: 1,600 ha.
Altitude: 4,795m.
Province and type: 8.36.12; 12 & 19.
Site description: A freshwater lake of 1,250 ha, several smaller lakes nearby and associated bogs in the high Andes.
Principal vegetation: No information.
Land tenure: No information.
Protection: None.
Land use: No information.
Waterfowl: No information.
Other fauna: No information.
Threats: No information.
References: ONERN (1980).
Source: Centro de Datos para la Conservacion.
Criteria for inclusion: 0.

Laguna Lagunillas (31)

Location: 15°43'S, 70°42'W; 75 km west of Puno, Puno Department.
Area: 5,090 ha.
Altitude: 4,160m.
Province and type: 8.36.12; 12 & 19.
Site description: A large permanent oligosaline lake and marshes in the high Andean puna zone with surrounding bogs (bofedales).
Principal vegetation: Beds of *Myriophyllum*, *Zanichellia* and *Potamogeton strictus* extending to up to 2,500m offshore; some submergent *Chara* and *Elodea*.
Land tenure: No information.
Protection: None.
Land use: Livestock grazing on the lake shore.
Waterfowl: A very important breeding area for waterfowl. Breeding birds observed by Fjeldsa in December 1977 included 100 *Rollandia rolland*, *700-800 Podiceps occipitalis*, *700-800 Phalacrocorax olivaceus*, *150-200 Nycticorax nycticorax*, *100 Chloephaga melanoptera*, *200 Lophonetta specularioides*, *200 Anas flavirostris*, *500-600 A. puna*, *1,000 A. georgica*, *250 Oxyura jamaicensis ferruginea*, 1,300-1,500 adult and 850-1,000 young *Fulica gigantea*, 60-70 *Charadrius alticola* and 1,000 *Larus serranus*. Also present were 500 *Phoenicopterus chilensis*, a few *Phoenicoparrus andinus*, 6,000 *Fulica americana/ardesiaca*, thousands of *Calidris bairdii* and 200 *Larus pipixcan*.

Other fauna: An abundant fish population including *Orestias* sp, *Odonthstes* sp and *Salmo gairdnieri*; the toad *Telmatobius culeus escomeli*; and a rich invertebrate fauna including the endemic snail *Littoridina saracochae*.
Threats: There is a little disturbance from the collection of birds' eggs for human consumption.
Research and conservation: An important area well deserving of further study.
References: ONERN (1980); Fjeldsa (1981a & 1981d).
Source: Jon Fjeldsa, Centro de Datos para la Conservacion, and R. A. Hughes.
Criteria for inclusion: 1c, 2b & 3a.

Laguna Saracocha (32)

Location: 15°46'S, 70°37'W; 65 km west of Puno, Puno Department.
Area: 1,470 ha.
Altitude: 4,145m.
Province and type: 8.36.12; 12 & 19.
Site description: A permanent very slightly brackish lake and marshes in the high Andean puna zone, with surrounding bogs (bofedales). The maximum depth of the lake is 75m.
Principal vegetation: Some *Scirpus* marshes.
Land tenure: No information.
Protection: None.
Land use: The main Puno to Arequipa Highway passes along the edge of the lake.
Waterfowl: Very close to Laguna Lagunillas, and with a similar bird fauna, including a large breeding population of *Fulica gigantea*. Up to 205 *Phoenicopterus chilensis* have been recorded as non-breeding visitors.
Other fauna: Fishes include *Orestias* sp and *Salmo gairdnieri*.
Threats: None known.
Research and conservation: No detailed surveys appear to have been conducted, despite the lake's accessibility.
References: Hurlbert (1978); ONERN (1980).
Source: Centro de Datos para la Conservacion and R. A. Hughes.
Criteria for inclusion: 1c.

Laguna Umayo (33)

Location: 15°44'S, 70°12'W; 20 km northwest of Puno, Puno Department.
Area: Lake 2,940 ha, flood zone 15,500 ha.
Altitude: 3,820m.
Province and type: 8.47.14; 12 & 16.
Site description: A permanent freshwater lake, up to 40m deep, with fringing marshes, and a large area of seasonally flooded puna grassland, in the Titicaca basin. The lake is linked to Lake Titicaca by the Illpa River, and must at one time have been a part of that lake. Water levels reach their lowest between July and September.
Principal vegetation: Extensive beds of submergent *Lilaeopsis, Elodea, Potamogeton, Chara* and *Myriophyllum elatinoides*; marshes with *Scirpus riparius*.
Land tenure: State owned.
Protection: None.
Land use: Hunting, fishing, livestock grazing and intensive harvesting of reeds. There are several small villages and some agriculture in the area; and a considerable amount of tourism to the Inca burial mounds on a peninsula in the lake (Sillustani).
Waterfowl: A very rich lake for breeding waterfowl typical of the Titicaca basin, and with a large population of the local Short-winged Grebe *Rollandia micropterum*. In December 1977, Fjeldsa observed 300 *Rollandia rolland*, 700 *R. micropterum*, 1,300 *Podiceps occipitalis*, 100 *Nycticorax nycticorax*, over 1,000 ducks of five species, 400 *Gallinula chloropus*, 700 *Fulica americana/ardesiaca* and several thousand Nearctic shorebirds (*Tringa melanoleuca, T. flavipes, T. solitaria, Calidris bairdii* and *C. melanotos*). Up to 500 *Phoenicopterus chilensis* have occurred as non-breeding visitors, *Theristicus (c.) branickii* occurs on the surrounding

grassland, and *Anas platalea* has been recorded.
Other fauna: The fishes include *Salmo gairdnieri, Odonthestes bonariensis* and *Orestias* spp.
Threats: Over-harvesting of the aquatic vegetation may become a problem, and there is some pollution from nearby villages. Birds' eggs are collected for human consumption, and many grebes are drowned in fishing nets.
Research and conservation: Easy access from Puno, considerable archeological interest, and a rich bird fauna make this lake an excellent site for a nature sanctuary/national monument.
References: Hurlbert (1978); Fjeldsa (1981d).
Source: Centro de Datos para la Conservacion, Jon Fjeldsa and R. A. Hughes.
Criteria for inclusion: 2b & 3a.

Marshes of the Rio Ayaviri (34)

Location: 14°40'-14°55'S, 70°45'-70°50'W; between Ayaviri and Santa Rosa, Puno Department.
Area: 40 km of river.
Altitude: 3,880m.
Province and type: 8.36.12; 10 & 16.
Site description: A fast-flowing river, some associated marshes, and a large adjacent area of seasonally flooded puna grassland. The greater part of the area dries out completely during the dry season.
Principal vegetation: Mainly short grass, with large areas of *Festuca* and *Juncus*.
Land tenure: No information.
Protection: None.
Land use: Cattle grazing.
Waterfowl: An important feeding area for waterfowl; in November/December 1977 and December 1983, Fjeldsa observed large numbers of *Nycticorax nycticorax, Plegadis ridgwayi, Chloephaga melanoptera, Anas flavirostris, A. georgica* and *Vanellus resplendens. Theristicus (c.) branickii* was also present in small numbers, and the area appeared very suitable for a variety of Nearctic shorebirds.
Other fauna: No information.
Threats: None known.
Source: Jon Fjeldsa.
Criteria for inclusion: 0.

Laguna Arapa and Taraco wetlands (35)

Location: 15°15'S, 69°52'W; between Taraco and Huancane, northwest of Lake Titicaca, Puno Department.
Area: 33,800 ha.
Altitude: 3,810m.
Province and type: 8.47.14; 09, 11, 12 & 16.
Site description: Laguna Arapa (16,300 ha) is a permanent shallow freshwater lake with extensive marshes, bounded by hills to the north. The lake drains into the Rio Ramis, which meanders across the plains to the south, unites with the Rio Carabaya, and eventually flows into Lake Titicaca. During the summer rains, the river overflows and floods up to 17,500 ha of puna grassland, almost connecting L. Arapa with Lake Titicaca. Some small ponds, patches of marsh and damp meadows remain through the dry season.
Principal vegetation: Beds of *Myriophyllum* and *Lemna* in L. Arapa and permanent ponds; marshes with *Scirpus californicus*.
Land tenure: No information.
Protection: None.
Land use: Livestock grazing, reed-cutting, and agriculture.

Waterfowl: An important breeding area for some species, and a very important feeding area for waterfowl breeding around Lake Titicaca and for Nearctic shorebirds. Breeding species include *Rollandia rolland* (thousands), *R. micropterum* (on L. Arapa and L. Cupisco), *Nycticorax nycticorax* (up to 400), *Plegadis ridgwayi* (up to 1,300), a variety of Anatidae, *Gallinula chloropus* (many thousands), and *Fulica americana/ardesiaca*. Up to 1,000 *Phoenicopterus chilensis* have been recorded and *Theristicus (c.) branickii* occurs in the area. Counts of shorebirds have included several thousand *Tringa melanoleuca* and *T. flavipes*, and several hundred *Calidris bairdii, C. melanotos, Micropalama himantopus, Steganopus tricolor* and *Himantopus himantopus*.

Other fauna: The fishes include *Salmo gairdnieri, Odonthestes bonariensis* and *Orestias* spp.

Threats: Large areas of the seasonally flooded grassland are being converted to agricultural land. .

References: Fjeldsa (1981d).

Source: Jon Fjeldsa, R. A. Hughes and Centro de Datos para la Conservacion.

Criteria for inclusion: 2b & 3a.

Lake Titicaca (36)

Location: 15°40'S, 69°40'W; on the Peruvian/Bolivian border, Puno Department.

Area: Entire lake 830,000 ha; about 460,000 ha in Peru.

Altitude: 3,810m.

Province and type: 8.47.14; 12 & 16.

Site description: A large permanent freshwater lake, up to 272m deep, on a high Andean plateau; with several islands, extensive areas of emergent aquatic vegetation and adjacent areas of seasonally inundated puna grassland. The water level fluctuates by about one metre, and reaches its maximum at the end of the rainy season (November-March). There is a particularly large area of marsh near Puno (28,000 ha), which extends up to 12 km out into the lake.

Principal vegetation: The submergent vegetation includes *Elodea* sp and various algae; the floating vegetation includes species of *Lemna, Azolla, Chara* and *Myriophyllum*; and the dominant emergent is *Schoenoplectus tatora*.

Land tenure: State owned.

Protection: 36,180 ha are protected within the Titicaca National Reserve, established in 1978. The Reserve is in two separate sections; the Ramis area (7,030 ha) at the northern tip of the lake, and the Puno section (29,150 ha) near the town of Puno.

Land use: Traditional fishing, hunting, reed-cutting, grazing of livestock on the lake shore and on seasonally flooded grassland, tourism and transportation.

Waterfowl: An extremely important area for Andean waterfowl and Nearctic shorebirds. The commoner resident species include *Rollandia rolland, R. micropterum, Phalacrocorax olivaceus, Nycticorax nycticorax, Plegadis ridgwayi, Chloephaga melanoptera, Anas flavirostris, A. georgica, A. puna, A. cyanoptera, Oxyura jamaicensis ferruginea, Gallinula chloropus, Fulica americana/ardesiaca, Vanellus resplendens, Charadrius alticola, Himantopus himantopus* and *Larus serranus*. Up to 5,000 *Phoenicopterus chilensis* have been recorded as non-breeding visitors. The most abundant Nearctic shorebirds are *Pluvialis dominica, Tringa melanoleuca, T. flavipes, Calidris bairdii, C. melanotos* and *Steganopus tricolor*.

Other fauna: The fish fauna includes many species of *Orestias, Pygidium* sp, *Odonthestes bonariensis* and the introduced *Salmo gairdnieri*. Amphibians include *Bufo spinulosus, Gastrotheca marsupiata* and three species of *Telmatobius*.

Threats: There is a considerable amount of pollution in the Puno area from domestic sewage and boat traffic, and excessive utilization of reeds for building, boat construction and handicrafts. Hunting and the collection of birds' eggs may be a problem in some areas, and many grebes are known to drown in fishing nets.

Research and conservation: A variety of limnological studies and fisheries investigations have been carried out, and a master plan has been prepared for the National Reserve. The avifauna of the lake is well known, but very few census data are available.

References: Matos (1957); Barreda (1970); Tovar (1971); Dourojeanni (1975); Rivera Concha (1977); Hurlbert (1978); Acosta (1979); CEPID (1979); Universidad Nacional Agraria (1979); Fjeldsa (1981d).

Source: Eric Cardich, Victor Pulido, Jon Fjeldsa and Centro de Datos para la Conservacion.
Criteria for inclusion: 123.

Laguna Salinas (37)

Location: 16°21'S, 71°12'W; 40 km east of Arequipa, Arequipa Department.
Area: 7,100 ha.
Altitude: 4,295m.
Province and type: 8.36.12; 14 & 19.
Site description: A large semi-permanent and very shallow hypersaline lake in a high Andean basin, with numerous small freshwater springs and bogs (bofedales) around its perimeter, and extensive bare salt flats at low water levels. The water level fluctuates greatly from year to year depending on the local rainfall, and in drought years the lake dries out completely except for some small spring-fed pools. Such was the case during the drought of 1982 and 1983, but the heavy rains in early 1984 rapidly filled the lake to its maximum level. In most years, levels reach their highest in April or May, and from September to January most of the basin is dry.
Principal vegetation: Bofedales with *Oxychloe andina*, and dry puna grassland with species of *Festuca, Parastrephia* and *Astragalus.* The lake itself is devoid of macrovegetation.
Land tenure: Owned by local Indian communities.
Protection: Within the Salinas y Aguada Blanca National Reserve (366,936 ha) established in 1979.
Land use: Some exploitation of salt deposits. Livestock grazing and a little traditional farming in surrounding areas.
Waterfowl: A very important lake for flamingos, with all three Andean species occuring in large numbers at times of high water levels. As water levels fall and salinities increase, *Phoenicoparrus jamesi* predominates. As many as 20,000 flamingos have been observed on several occasions. *Phoenicopterus chilensis* and *Phoenicoparrus jamesi* are certainly much commoner than *P. andinus*, but detailed breakdown by species has rarely been possible. Many other high Andean waterfowl occur in smaller numbers, including *Recurvirostra andina*, and *Steganopus tricolor* is at times common. *Thinocorus orbignyianus* is common on the bofedales, and *Attagis gayi* occurs in the surrounding hills.
Other fauna: *Vicugna vicugna* and *Hippocamelus antisensis* occur in the Reserve.
Threats: None known.
References: Kahl (1975); Hurlbert (1978); IUCN (1982).
Source: Centro de Datos para la Conservacion, R. A. Hughes and Derek A. Scott.
Criteria for inclusion: 1b & 3a.

Laguna Suches (38)

Location: 16°56'S, 70°24'W; 125 km SSW of Puno, Tacna Department.
Area: 1,560 ha.
Altitude: 4,452m.
Province and type: 8.36.12; 12 & 19.
Site description: A permanent freshwater lake, up to 12m deep, and marshes with surrounding bogs (bofedales) in the high Andes. The lake is the source of the Rio Locumba.
Principal vegetation: In a region of arid puna grassland.
Land tenure: No information.
Protection: None.
Land use: The water is used by a nearby town and mine.
Waterfowl: An important breeding area for high Andean species, including *Podiceps occipitalis* (hundreds), *Chloephaga melanoptera, Anas puna, Fulica gigantea* (hundreds), *Recurvirostra andina, Thinocorus orbignyianus* and *Attagis gayi.* Up to 200 *Phoenicopterus chilensis* have been recorded as non-breeding visitors.
Other fauna: The puna around the lake is one of the few areas in Peru where the Puna Rhea *Pterocnemia pennata tarapacensis* still occurs.
Threats: No information.

References: Hurlbert (1978).
Source: R. A. Hughes and Centro de Datos para la Conservacion.
Criteria for inclusion: 1c & 2a.

Laguna Vizcacha (39)

Location: 16°53'S, 70°14'W; 20 km west of Laguna de Loriscota, Moquegua Department.
Area: 865 ha.
Altitude: 4,575m.
Province and type: 8.36.12; 12 & 19.
Site description: A permanent lake, up to 1m deep, and surrounding bogs (bofedales), in the high Andes between Laguna de Loriscota and L. Suches. The lake is normally fresh, but becomes saline during periods of drought.
Principal vegetation: No information.
Land tenure: No information.
Protection: None.
Land use: No information.
Waterfowl: Up to 640 *Phoenicopterus chilensis*, 200 *Phoenicoparrus andinus* and 740 *P. jamesi* have occurred as non-breeding visitors. There are large populations of *Chloephaga melanoptera* and other Anatidae, and *Steganopus tricolor* is a common migrant.
Other fauna: *Salmo gairdnieri* has been introduced into the lake.
Threats: No information.
References: Hurlbert (1978); ONERN (1980).
Source: T. Moreno and Centro de Datos para la Conservacion.
Criteria for inclusion: 1b.

Laguna de Loriscota (40)

Location: 16°52'S, 70°02'W; 110 km southwest of Puno, Puno Department.
Area: 3,450 ha.
Altitude: 4,663m.
Province and type: 8.36.12; 14 & 19.
Site description: A permanent saline lake, up to 2.6m deep, with surrounding bogs (bofedales) in the high Andes. A salinity of 10.4 p.p.t. has been recorded.
Principal vegetation: No information.
Land tenure: No information.
Protection: None.
Land use: No information.
Waterfowl: Small numbers of flamingos have been recorded on several occasions, and about 590 *Phoenicopterus chilensis*, 1,230 *Phoenicoparrus andinus* and 75 *P. jamesi* were present in early February 1985. Other waterfowl present at this time included 400 *Chloephaga melanoptera*, 600 other Anatidae, 200 *Calidris bairdii* and 1,000 *Steganopus tricolor*.
Other fauna: The Puna Rhea *Pterocnemia pennata tarapacensis* still occurs in the area. There are no fish in the lake.
Threats: The entire lake is being drained as part of a water development project.
References: Hurlbert (1978).
Source: R. A. Hughes, Stuart Hurlbert, T. Moreno and Centro de Datos para la Conservacion.
Criteria for inclusion: 1b.

Laguna Aricota (41)

Location: 17°22'S, 70°19'W; 75 km north of Tacna, on the Pacific slope of the Andes, Tacna Department.
Area: 1,450 ha.

Altitude: 2,800m.
Province and type: 8.37.12; 12.
Site description: A permanent freshwater lake in a deep Andean valley on the arid Pacific slope; one of the very few lakes at mid-elevations on the Pacific slope of southern Peru and northern Chile.
Principal vegetation: No information.
Land tenure: No information.
Protection: None.
Land use: The lake has been dammed to provide water for irrigation and there is some mining in the area.
Waterfowl: No information.
Other fauna: No information.
Threats: No information.
Research and conservation: Possibly a very interesting lake because of its unique situation. A thorough survey is urgently required, particularly in view of the possible detrimental effects of the damming and mining activities.
References: ONERN (1980).
Source: Centro de Datos para la Conservacion.
Criteria for inclusion: 0.

Lakes and marshes along the lower Rio Pastaza (42)

Location: 3°18'-4°56'S, 76°12'-76°50'W; the lower Rio Pastaza to its confluence with the Rio Marañon, Loreto Department.
Area: 200 kms of river; area of marshes unknown.
Altitude: 180-220m.
Province and type: 8.5.1; 09, 11, 12 & 18.
Site description: A complex of freshwater lakes, marshes, oxbow lakes, riverine marshes, and swamp forest along the lower Rio Pastaza, a large slow-flowing river meandering through humid tropical forest. The largest lakes are Laguna Rimachi (300 ha) on the west bank of the Pastaza, and Laguna Papayacu, near the confluence of the Pastaza and Marañon.
Principal vegetation: Extensive areas of "varzea" forest, i.e. successional stages of riverine forest subject to seasonal flooding. In a region of humid tropical forest.
Land tenure: State owned.
Protection: None.
Land use: No information.
Waterfowl: No information.
Other fauna: No information.
Threats: No information.
Research and conservation: A remote and little known area.
Source: Centro de Datos para la Conservacion.
Criteria for inclusion: 0.

Wetlands in Pacaya-Samiria National Reserve (43)

Location: 5°00'S, 74°30'W; between the Rio Marañon and the Rio Ucayali, Loreto Department.
Area: Unknown.
Altitude: 125-800m.
Province and type: 8.5.1; 09, 11, 12 & 18.
Site description: A extensive alluvial plain in a depression in the lower basins of the Rio Marañon and Rio Ucayali; wetland habitats include slow-flowing meandering rivers with sandbanks and associated riverine forest and marshes, over 150 oxbow lakes of between 100 and 500 ha in area, and large tracts of seasonally inundated swamp forest.
Principal vegetation: "Varzea" forest and humid tropical forest.
Land tenure: State owned.

Protection: Within the Pacaya-Samiria National Reserve (2,080,000 ha) established in 1977 and increased to its present size in 1982.
Land use: Traditional hunting, fishing and slash-and-burn cultivation by indigenous groups living in the Reserve.
Waterfowl: Very poorly known, but it can be assumed that most if not all of the characteristic waterfowl of the western Amazon basin occur. Birds observed during a two day boat journey down the Ucayali in November 1974 included large numbers of *Phalacrocorax olivaceus, Ardea cocoi, Mycteria americana, Anhima cornuta, Rynchops niger, Phaetusa simplex* and *Sterna superciliaris.*
Other fauna: The Reserve has a very rich and diverse fauna and flora. Mammals include *Inia geoffrensis, Sotalia fluviatilis* and *Trichechus inunguis*, and reptiles include *Caiman crocodilus, Melanosuchus niger, Podocnemis unifilis, P. expansa* and *Testudo denticulata.* Over 40 Ospreys *Pandion haliaetus* were observed in a two day boat journey down the Rio Ucayali in November 1974.
Threats: Wardening of the Reserve is reported to be totally inadequate, and there is uncontrolled hunting and habitat destruction by settlers along the river banks.
Research and conservation: An extremely rich area for wildlife and a National Reserve, and yet very poorly known.
References: Hoffman & Ponce (1968); Byskov (1974); IUCN (1982).
Source: Centro de Datos para la Conservacion.
Criteria for inclusion: 123.

Flood plain of the Rio Ucayali (44)

Location: 6°00'-8°00'S, 74°42'-75°10'W; along the Rio Ucayali, south of the Pacaya-Samiria National Reserve, Loreto Department.
Area: c.630,000 ha.
Altitude: 150m.
Province and type: 8.5.1; 09, 11, 12 & 18.
Site description: A large slow-flowing meandering river with sand banks, over 130 oxbow lakes of more than 25 ha in area, several larger freshwater lakes and marshes including the Laguna Inuria and L. Chioa complex (1,600 ha), and a large area of seasonally inundated swamp forest.
Principal vegetation: Humid tropical forest, with large tracts of "varzea" forest.
Land tenure: State owned.
Protection: None.
Land use: No information.
Waterfowl: No information; presumably similar to that of the Pacaya-Samiria National Reserve.
Other fauna: No information.
Threats: No information.
Source: Centro de Datos para la Conservacion.
Criteria for inclusion: 0.

Laguna de Yarinacocha (45)

Location: 8°19'S, 74°35'W; 5 km northwest of Pucalpa, Ucayali Department.
Area: 1,667 ha.
Altitude: 150m.
Province and type: 8.5.1; 11 & 18.
Site description: A particularly large oxbow lake of the Rio Ucayali, with associated marshes and swamp forest.
Principal vegetation: Humid tropical forest, "varzea" forest, and bamboo thickets.
Land tenure: State owned.
Protection: No habitat protection, but hunting is prohibited.
Land use: Traditional fishing, boat transport and tourism. The lake is used as a landing strip for sea-planes.

Waterfowl: Thirty-five species of waterfowl have been recorded including most species typical of oxbow lakes and swamp forest of the Amazon basin. The commoner species include *Anhinga anhinga, Butorides striatus, Anhima cornuta, Opisthocomus hoazin, Aramides cajanea, Laterallus fasciatus, Jacana jacana* and *Phaetusa simplex.* Other species typical of this habitat include *Pilherodius pileatus, Tigrisoma lineatum, Cochlearius cochlearius, Cairina moschata, Heliornis fulica* and *Eurypyga helias.* The rare *Zebrilus undulatus* has also been recorded.
Other fauna: Over 400 species of birds have been recorded in the area, including all five South American kingfishers Alcedinidae and a wide variety of birds of prey associated with marsh and riverine habitats. Mammals include *Hydrochoerus hydrochaeris.*
Threats: Continuing human settlement and the associated forest clearance are affecting the region as a whole, and there is some illegal hunting.
Research and conservation: The avifauna of the Yarinacocha area has been well documented.
References: Pearson (1971); O'Neill & Pearson (1974); O'Neill (1978).
Source: Eric Cardich and Victor Pulido.
Criteria for inclusion: 3a.

Wetlands in Manu National Park (46)

Location: 11°30'-13°00'S, 71°00'-72°20'W; in the Provinces of Manu and Paucartambo, Departments of Madre de Dios and Cusco.
Area: Area of wetlands unknown.
Altitude: 240-4,500m.
Province and type: 8.5.1/8.35.12; 09, 10, 11 & 18.
Site description: The whole of the hydrographic catchment area of the Rio Manu and part of the catchment of the Alto Madre de Dios. Wetland habitats include clear fast-flowing mountain rivers and streams in humid temperate and subtropical forest; and wide slow-flowing rivers with beaches and sand banks, and associated oxbow lakes, marshes and swamp forest, in humid tropical forest. There are some 13 large oxbow lakes and 100 beaches along the Rio Manu from Cocha Cashu to its confluence with the Alto Madre de Dios. Cocha Cashu is an oxbow lake of 34 ha near the research station in the Park.
Principal vegetation: The full spectrum of humid forest and riverine habitat types from the edge of the paramo at over 4,000m to lowland Amazon forest at 240m. The oxbow lakes have an abundant growth of floating and emergent vegetation.
Land tenure: State owned, with some indigenous groups living in the area.
Protection: Within the Manu National Park (1,532,806 ha) and Manu National Forest, established in 1973. Part of the National Park, the National Forest, and some adjacent lands were designated as a Biosphere Reserve of 1,881,200 ha in 1977.
Land use: Most of the area is still in pristine condition. Rational use of timber is permitted in the National Forest, and there is some traditional agriculture and stock raising in the buffer zone of the Biosphere Reserve.
Waterfowl: The waterfowl of the lower Rio Manu and Cocha Cashu area have been well documented; 47 species have been recorded including most species typical of Amazonia, e.g. *Anhinga anhinga, Tigrisoma lineatum, Pilherodius pileatus, Agamia agami, Mesembrinibis cayennensis, Anhima cornuta, Neochen jubata, Cairina moschata, Opisthocomus hoazin, Aramides cajanea, A. calopterus, Porphyrula martinica, Heliornis fulica, Eurypyga helias, Jacana jacana, Hoploxypterus cayanus, Charadrius collaris, Phaetusa simplex, Sterna superciliaris* and *Rynchops niger.* Eight species of Nearctic shorebirds have been recorded in small numbers on passage. The avifauna of the temperate and subtropical portions of the Park is much less well known, and no information is available on the waterfowl.
Other fauna: In terms of species diversity, the forests of Manu constitute one of the richest areas hitherto known in the world. The avifauna alone probably exceeds 850 species. In addition to the true waterfowl, about 70 species are restricted to riverine and lacustrine habitats, particularly the "varzea" forests. Mammals and reptiles associated with the wetland habitats include *Tapirus terrestris, Hydrochoerus hydrochaeris, Caiman crocodilus, Melanosuchus niger, Platemys platycephala* and *Podocnemis unifilis.*
Threats: There is a potential threat of interference from oil exploration in the Park in the future.

Research and conservation: A wide variety of biological investigations are being conducted from the research station at Cocha Cashu, and a management plan for the Park has been produced.
References: Tosi (1960); Dourojeanni (1968 & 1973); Tovar (1970); Hoffman & Ponce (1971); Ruiz (1979); Terborgh & Fitzpatrick (1979); IUCN (1982).
Source: Eric Cardich and Victor Pulido.
Criteria for inclusion: 123.

Wetlands in the Tambopata Wildlife Reserve (47)

Location: 12°50'S, 69°18'W; 30 km southwest of Puerto Maldonado, at the confluence of the Rio Tambopata and Rio La Torre, Madre de Dios Department.
Area: c.1,000 ha.
Altitude: 250m.
Province and type: 8.5.1; 09, 11 & 18.
Site description: A good example of a typical west Amazonian riverine system, with slow-flowing rivers with beaches and sand banks, riverine thickets, oxbow lakes and marshes with stands of *Mauritia* palms, forest streams, and extensive areas of low-lying poorly drained forest subject to inundation during the rainy season (November to April).
Principal vegetation: In a relatively undisturbed area of humid tropical forest. The riverine thickets are dominated by species of *Cecropia* and *Erythrina*, and *Gynerium* cane.
Land tenure: State owned, but managed by a private company with tourist interests (Peruvian Safaris, S. A.).
Protection: The area was declared a Wildlife Reserve of 5,500 ha in 1977, but there has never been any wardening by Government personnel.
Land use: Wildlife oriented tourism and scientific research. There is a small hotel in the Reserve.
Waterfowl: Over 50 species of waterfowl have been recorded in the Reserve, but only about 20 are breeding residents, and densities are low. The commoner breeding species include *Anhinga anhinga, Pilherodius pileatus, Tigrisoma lineatum, Mesembrinibis cayennensis, Anhima cornuta, Cairina moschata, Opisthocomus hoazin, Aramides cajanea, Laterallus melanophaius, Heliornis fulica, Eurypyga helias, Jacana jacana* and *Hoploxypterus cayanus*. The rare *Zebrilus undulatus* has been recorded on a number of occasions, and there is probably a small resident breeding population in the Reserve. A variety of Ardeidae and Rallidae occur as wet season visitors, and eight species of Nearctic shorebirds have been recorded in small numbers on migration.
Other fauna: Over 540 species of birds have been recorded in the 5,500 ha Reserve; many of these, including a number of birds of prey and five species of Alcedinidae, are depedent on the wetland habitats. There is a rich mammalian and reptilian fauna including *Hydrochoerus hydrochaeris, Pteronura brasiliensis, Tapirus terrestris, Caiman crocodilus* and *Melanosuchus niger*.
Threats: There is some illegal hunting and felling of valuable timber in the Reserve, and constant pressure from settlers along the river banks.
Research and conservation: Detailed investigations on the fauna and flora of the Reserve are continuing. Repeated efforts have been made to extend the reserve to include both banks of the Rio Tambopata, and it is understood that some progress is now being made.
References: Davis *et al* (1980); Donahue (1981); IUCN (1982); Parker (1982).
Source: Derek A. Scott.
Criteria for inclusion: 2a, 2b & 3a.

Rio Heath and Pampas de Heath (48)

Location: 12°53'S, 68°54'W; on the Peruvian/Bolivian border 50 km southeast of Puerto Maldonado, Madre de Dios Department.
Area: 5,000 ha of seasonally flooded grassland.
Altitude: 160m.

Province and type: 8.5.1; 16.
Site description: Several "islands" of seasonally flooded grassland surrounded by forest on the west bank of the Rio Heath. These pampas are the most northern incursion of the extensive Beni savannas of northern Bolivia, and constitute the only example of this habitat type in Peru. The pampas are characterized by very humid soils and expanses of grasses and sedges with small groves of palms and other trees. Gallery forest extends along the streams and is continuous with the surrounding humid tropical forest. Flooding occurs from October to June.
Principal vegetation: Grasses, sedges and groves of *Mauritia* palms.
Land tenure: No information.
Protection: None.
Land use: Some livestock grazing by the indigenous Huarayo Indians. Parts of the grassland are burned annually to improve the grazing.
Waterfowl: The area has apparently only been surveyed once, in the dry season of 1977, and its importance for waterfowl is unknown. Two species of Rallidae *Porzana albicollis* and *Micropygia schomburgkii* were recorded for the first time in Peru.
Other fauna: During their survey in June/July 1977, Graham *et al* recorded 17 species of birds new for Peru.
Threats: No information.
Research and conservation: A proposal has been made for the creation of a reserve in the area. A thorough survey of the area during the wet season is called for.
References: Graham *et al* (1980).
Source: See references.
Criteria for inclusion: 2b.

SURINAME

INTRODUCTION

by **Ben H. J. de Jong and Arie L. Spaans**, in cooperation with **Muriel Held**

Suriname is located on the northern coast of South America and is bounded in the west by Guyana, in the east by French Guiana, and in the south by Brazil. The total area is approximately 163,000km^2. The country lies just north of the equator, between 2° and 6° north, and the climate is humid tropical under the influence of the northeast trade winds. Temperatures are uniformly high (average of 27°C in Paramaribo), and rain falls throughout the year (average annual precipitation of 2,200 mm in Paramaribo). However, four seasons can be distinguished: a short dry season in February and March; a long rainy season from April to August; a long dry season from September to November; and a short rainy season in December and January.

Ninety-five per cent of the population of 350,000 is concentrated in and around the capital of Paramaribo and in smaller settlements on the coastal plain. There are only small scattered settlements of Amerindians and Bush-negroes (descendants of runaway slaves) along the rivers of the interior, and large tracts of the country are uninhabited. About eighty-five per cent of the land remains covered with undisturbed tropical rain forest.

Geologically the country can be divided into four regions: the young coastal plain; old coastal plain; savanna belt or Zanderij landscape; and interior, or crystalline basement.

a) The young coastal plain (1,620,000 ha; 0-4m above mean sea level) is approximately 8 km wide in the east and broadens to 50 km wide in the west. It consists of Holocene marine swamp clays, which in places are dissected by sand and shell ridges. The coastal zone is comprised of vast tidal mudflats, some narrow sandy beaches, and mangrove swamps. Inland, the coastal fringe is bordered by shallow saline and brackish lagoons and swamps with some mangrove forests. Further inland the marshes become fresh, and there are patches of swamp forest dominated by *Erythrina glauca*, and mixed dryland forests on sandy ridges. The five major wetland areas of this zone, totalling 325,000 ha, are all of international importance as wintering and staging areas for migratory shorebirds and breeding areas for various Ardeidae and Anatidae.

b) The old coastal plain (430,000 ha; 4-11m above mean sea level) is approximately 20 km wide, and consists of swamp clays of marine origin and sand ridges of both marine and riverine origin. The ridges diminish in size from east to west, and are absent in the Nanni-Maratakka area and neighbouring Guyana. There are various types of grassy swamp, swamp forest and dryland forest similar to those of the young coastal plain, but in addition there are large areas of ombrogenous peat swamp. The extensive tracts of wetland habitat in this zone remain very poorly known.

c) The savanna belt, or Zanderij landscape (1,000,000 ha; ten to several tens of metres above mean sea level) is a dissected plain consisting of coarse sands and loams and is characterized by white sand savannas. The zone is covered with xerophytic and mesophytic dryland and swamp forests, and dry to very wet grass and shrub savannas. Wetland habitat occurs only in small scattered patches.

d) The interior, or crystalline basement (13,200,000 ha; 30-1,230m above mean sea level) is a dissected peneplain sloping gently up to about 300m above sea level in the south, and with ranges of hills up to 1,230m. The almost uninhabited lowlands are covered with primeval humid tropical forest, interrupted only by small patches of savanna, exposed rocky outcrops, and patches of marsh forest along the rivers and creeks. At higher elevations, sub-montane forests are found on deep soils, and xerophytic forests and shrubbery on shallow soils. Apart from the riverine and creek systems, the only significant wetlands in this zone are the huge recently constructed Brokopondo Lake and the Sipaliwini Savanna.

Institutional Base for Wetland Conservation and Research

Several governmental and non-governmental organizations are involved in the conservation and research of wetlands and their wildlife in Suriname. Some changes have recently been made in the responsibilities of the various organizations concerned, and the situation is still under review. The principal organizations and their current responsibilities are as follows:

The Nature Conservation Commission is the advisory body for the government on matters concerning nature conservation, including hunting legislation and the establishment of nature reserves, and is the scientific authority for CITES in Suriname.

The Interdepartmental Working Group Ecology Western Suriname is the scientific authority for ecological research in western Suriname; it was established to monitor the ecological consequences of the planned Western Suriname Hydroelectric Project. Plans exist to extend the authority to cover the entire country.

The Pesticides Working Group, set up under the supervision of the Ministry of Agriculture, Animal Husbandry and Fisheries, and working in collaboration with the Central Laboratory, is the advisory body for the government on matters concerning the legislation and use of pesticides.

The Ministry of Natural Resources and Energy is the authority responsible for the Game Law and for wildlife management within the Game Protection Area. The Ministry is currently involved in a revision of the Game Law and Game Resolution.

The Forest Service, in the Ministry of Natural Resources and Energy, is the authority for the Forestry Law; it is responsible for managing forest reserves, and for management, control and research in natural areas including wetlands.

The Nature Conservation Division, a department of the Forest Service, is the authority for the Nature Conservation Law. It is responsible for the management of nature reserves, nature conservation research and education, and wildlife management including hunting control. It is also the management authority for CITES in Suriname.

The Fisheries Department, in the Ministry of Agriculture, Animal Husbandry and Fisheries, is the authority for the Fish Protection Law and the Law on Sea Fishery. It is responsible for fisheries research and management, and control of fishing.

The Foundation for Nature Conservation in Suriname (STINASU) is a semi-governmental foundation responsible for nature tourism and education, fund-raising for conservation, and the sea turtle ranching project. It conducts research on sea turtles on behalf of the Forest Service.

The Hydraulic Research Institute, in the Ministry of Public Works, Telecommunication and Construction, conducts hydrological research and investigations on water quality.

The Bureau for Public Health, in the Ministry of Public Health, conducts ecological research in wetlands, on vectors such as insects and snails.

Progress in Wetland Conservation and Research

The Nature Protection Law of 1954, formulated by the Nature Conservation Commission, provided the legal basis for the establishment of nature reserves. Since 1954, nine reserves have been established, totalling 3.5% of the surface of Suriname. Management of the nature reserves has been entrusted to the Forest Service; in all cases there is a restriction on exploitation.

In 1969, the Foundation for Nature Preservation in Suriname (STINASU) was established by the Nature Conservation Division to stimulate, coordinate and finance scientific investigations in the reserves, and to distribute information at various levels, primarily for national education and publicity purposes. Promoting tourism within the nature reserves is now one of STINASU's major functions.

The Suriname forest policy is based on the Forest Law of 1947 which provides the legal base for the establishment of Forest Reserves. A proposal has recently been made for a revision in this law.

Wildlife legislation and law enforcement came into force with the Game Law of 1954. The latest amendment of the Game Resolution dates from 1970, but a revision has been proposed and is expected to come into force in the near future. The present legislation applies only to northern and western Suriname and to the Brokopondo storage basin and surrounding areas, while the new resolution will cover the entire country. In the southern region, hunting of game species will be possible throughout the year, with no bag limits or possession limits.

Of the nine existing nature reserves, three are important wetland areas: Wia-Wia Nature Reserve (36,000 ha); Coppename River Mouth Nature Reserve (12,000 ha); and Sipaliwini Nature Reserve (100,000 ha). The establishment of a further six nature reserves has been recommended by the Nature Conservation Commission and Forest Service. Four of these contain large wetland areas: Nanni (46,000 ha); Peruvia (32,000 ha); Kaboerikreek (65,000 ha); and Upper Coesewijne (25,000 ha). In addition, proposals have been made for the establishment of two large Special Management Areas. One of these would include the coastal estuarine zone (310,000 ha), with its extremely important mudflats, beaches, sand ridges, mangrove forests, coastal lagoons and swamps. The zone has a high natural production of marine and freshwater fishes and shrimps, and is very important for both resident and migratory waterfowl. As a special management area, the zone could be managed in a way which would guarantee the high natural production of the area. Any changes in management would then have to be weighed against their effects on natural production. The other proposed special management area (1,150,000 ha) would include the planned man-made lakes in western Suriname, and would allow measures to be taken to protect the rivers and lake basins. However, it now seems unlikely that any major dam building projects will be implemented in the near future, and if this is the case, this special management area will not be designated.

A number of land use plans have been prepared and approved, and others are in preparation. As a result of the recent economic recession, however, a number of projects have been halted or slowed down, and it is expected that some plans will be reviewed and changed when the economy improves. The Planning Law, formulated in 1973, has not as yet been officially enforced, and this has held up the designation of Special Management Areas. Other development plans include an increase in agricultural production, particularly in the northwestern part of the country, which would involve, among other things, the conversion of natural swamps into rice fields and the construction of water storage basins for irrigation in the dry season.

A considerable amount of research relevant to the conservation of wetlands and their wildlife has been conducted in Suriname. Some of the most important investigations are listed below.

a) Extensive studies were conducted in the 1960s on the oceanography, geomorphology, sedimentology, primary production and zoology of the coastal waters of Suriname and the other Guyanas.

b) Several studies have been conducted on the geology, geomorphology and pedology of the coastal plain (Augustinus, 1978; Pons, 1966; Veen, 1970), and detailed studies are being carried out by the Soil Mapping Division of the Ministry of Public Works, Telecommunication and Construction, in relation to agricultural development plans.

c) Macrobenthic investigations in the intertidal zone have been carried out at Weg naar Zee and Totness by Swennen *et al* (1982), and at Coppenamepunt by W. van Stockum (unpublished). A general hydrological monitoring programme is being conducted in the coastal zone by the Hydraulic Research Institute, and in 1982 and 1983, D. H. Resida carried out an investigation on the key factors affecting natural production in the Bigi Pan wetlands. Further inland, Leentvaar (1975, 1979) and Leentvaar *et al* (1976) have completed hydrobiological and hydrological studies in the Brokopondo Lake, and Sevenhuijsen (1977) has conducted a hydrological survey in the Nanni swamp.

d) Various floral investigations have been carried out, notably by Lindeman (1953) and Teunissen (1978a, 1978b) in the north, and Van Donselaar (1965, 1968) and Oldenburger *et al* (1973) in the savanna regions.

e) Numerous avifaunal investigations have been carried out, particularly by F. Haverschmidt from the 1940s to the 1970s, and by G. F. Mees in the 1960s and 1970s. Surveys of breeding colonies of Ciconiiformes were initiated in the 1960s by de Vries (1966) and Haverschmidt (1967), and these have been continued and expanded (Spaans, 1975a & 1975b; Spaans & de Jong, 1982; de Jong & Spaans, in press). Studies on waterfowl in recent years have included research on feeding ecology (Spaans *et al*, 1978); habitat selection (Swennen & Spaans, in press); the status and distribution of Ciconiiformes, Anatidae, shorebirds and Laridae (Harrington & Leddy, 1982b; Morrison, 1983a & 1983b; Spaans, 1975a, 1975b, 1978a, 1978b & 1984; Spaans *et al*, 1978; and Spaans & de Jong, 1982); and the biometry and moult patterns of shorebirds (Spaans, 1976, 1979 & 1980).

f) Bird banding studies were initiated in the 1960s by Haverschmidt who banded *Eudocimus ruber* nestlings in the coastal zone. Over 17,000 Nearctic shorebirds were banded by A. L. Spaans and P. van der Wielen between 1970 and 1980.

g) A considerable amount of research has been conducted on sea turtle, fish and shrimp populations, particularly by the Fisheries Department. Recent studies include work on the shrimp and fishes in estuaries and lagoons by Engel (1981); work on offshore fish populations by the German Technical Cooperation Project; and work on the ecology of riverine fishes by R. P. Vari. Schulz (1975) conducted a comprehensive study of sea turtles nesting on the beaches of Suriname, and this work has been continued by various researchers.

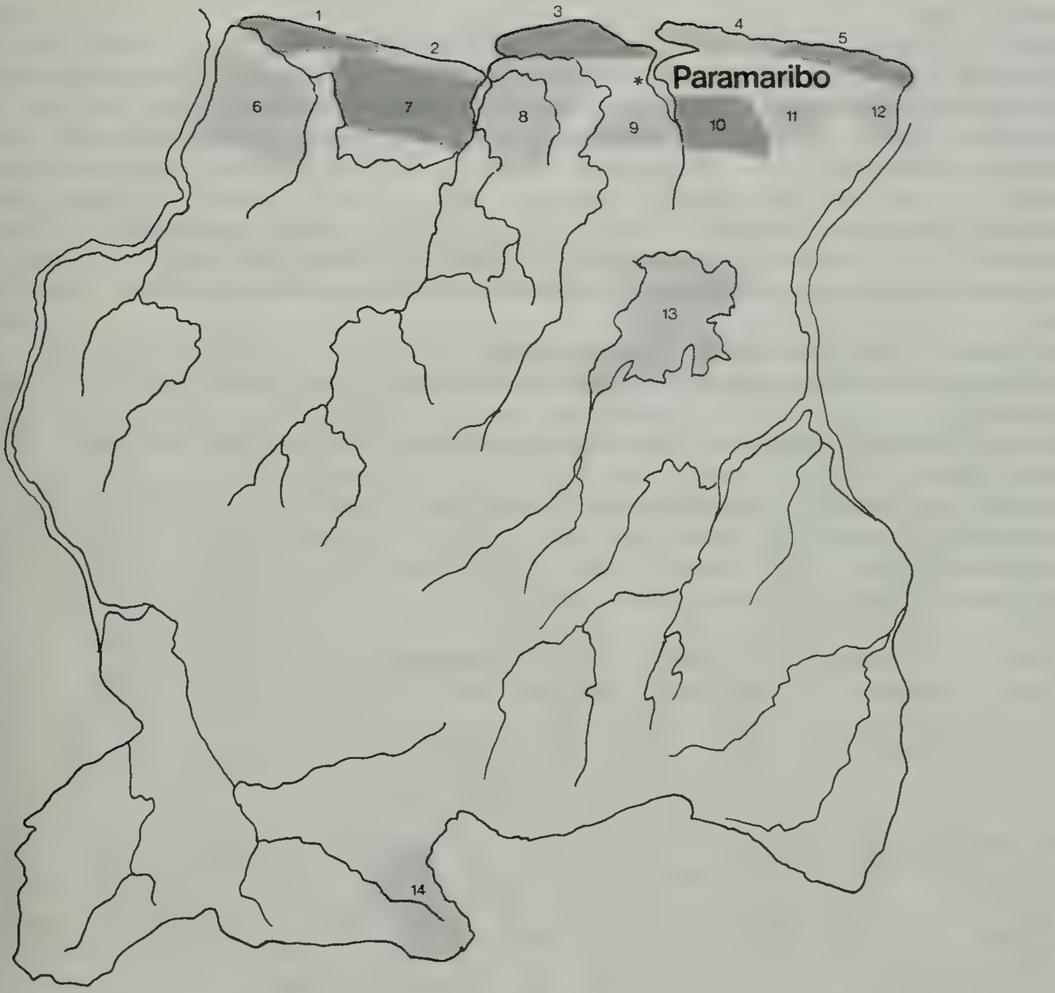
h) A variety of pesticide research projects were carried out in coastal areas during the 1970s (Vermeer *et al*, 1974; Spaans, 1982 & in press; R. Fyffe, B. H. J. de Jong & K. Mohadin, unpublished). Mohadin and Tjon Lim Sang (1980) conducted an ecological inventory of northern Saramacca District which included an assessment of the threats from pesticides on the Coppename River Mouth Nature Reserve.

Major Threats to Wetlands and Waterfowl

Most of the wetlands of Suriname remain relatively undisturbed, and some are virtually inaccessible. No serious threats exist at the present time, but future development plans are likely to increase the pressures on many wetlands. Agricultural activities are mostly concentrated in the coastal zone, where some swamps have been and are being converted into arable land, especially for rice culture. Increasing agricultural activity has resulted in an increase in the application of pesticides, and this could become a serious threat in the future. The construction of roads and dykes has caused some changes in the hydrology of certain wetlands, and this has affected their vegetation and overall ecology.

No species of waterfowl is thought to be endangered in Suriname, but hunting, the illegal collection of eggs and young of herons, storks and ibises (all protected by law), and the catching of ducklings, put pressure on some species in certain areas.

SURINAME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WETLANDS

Site descriptions based on data sheets provided by Ben H. J. de Jong and Arie L. Spaans, and subsequently published in de Jong & Spaans (1984).

Bigi Pan and Wageningen Swamps (1)

Location: 5°55'N, 56°45'W; east of Nickerie River mouth, north of Wageningen, and west of Burnside, Nickerie and Coronie Districts.
Area: 55,000 ha.
Altitude: 0-5m.
Province and type: 8.4.1; 02, 05, 06, 07, 08, 09, 12, 16 & 18.
Site description: The estuary of the River Nickerie and coast to the east, with extensive intertidal mudflats and mangrove swamps; bordered inland by a broad belt of shallow fresh to hypersaline lagoons, marshes and mangrove swamps, and a large area of seasonally inundated grassland and swamp forest. Large areas of swamp dry out completely during the long dry season.
Principal vegetation: Mangrove swamps dominated by *Avicennia germinans*; halophytic vegetation with *Sesuvium portulacastrum* and *Batis maritima*; brackish short grass swamps with *Eleocharis mutata*; marshes with *Typha angustifolia*; and swamp forest with *Erythrina glauca.*
Land tenure: Mainly state owned with some private holdings.
Protection: No habitat protection, but within the Game Protection Area in which hunting is controlled.
Land use: Hunting, fishing, grazing of livestock, rice cultivation, and extraction of sand along the sea beach.
Waterfowl: An extremely important area for breeding, passage and wintering waterfowl of a wide variety of species (68 species recorded). Common breeding species include *Podilymbus podiceps, Nycticorax nycticorax* (500 pairs), *Nyctanassa violacea* (2,000 pairs), *Cochlearius cochlearius* (750 pairs), *Egretta caerulea* (5,000 pairs), *E. tricolor* (4,000 pairs), *E. thula* (1,500 pairs), *E. alba* (1,500 pairs), *Ardea cocoi* (1,500 pairs), *Eudocimus ruber* (4,500 pairs in 1984, and up to 10,500 pairs in the early 1970s), *Dendrocygna autumnalis* (over 1,000 pairs), *Anas bahamensis* (over 1,000 pairs), *Cairina moschata, Aramus guarauna, Rallus longirostris, Aramides cajanea, Porphyrula martinica, Jacana jacana* and *Himantopus himantopus* (100s of pairs). Non-breeding visitors include over 2,000 *Phalacrocorax olivaceus*, 1,750 *Mycteria americana*, 70 *Jabiru mycteria*, 1,000 *Larus atricilla*, several thousand *Gelochelidon nilotica*, over 1,000 *Sterna superciliaris*, and 5,000-10,000 *Rynchops niger.*
Very large numbers of Nearctic shorebirds occur on migration and in winter. Recent estimates of the most abundant species are as follows: *Pluvialis squatarola* 2,000; *Charadrius semipalmatus* 4,000; *Numenius phaeopus* 1,000; *Tringa flavipes* 50,000; *T. melanoleuca* 12,000; *T. solitaria* 1,000s; *Actitis macularia* over 10,000; *Catoptrophorus semipalmatus* 15,000; *Arenaria interpres* over 5,000; *Limnodromus griseus* 30,000; *Calidris pusilla* 750,000-1,000,000; *C. mauri* 1,000s; *C. minutilla* 10,000; *C. fuscicollis* 10,000; and *Micropalama himantopus* 1,000s. *Anas discors* is also abundant on migration and in winter, and over 10,000 have been recorded.
Other fauna: Birds of prey include *Pandion haliaetus, Rostrhamus sociabilis* and *Buteogallus aequinoctalis*, and the deer *Odocoileus virginianus* occurs. The area is a very important nursery ground for coastal fishes and crustaceans.
Threats: There is illegal expansion of agriculture into the area and some illegal hunting. Agricultural activities in adjacent areas have resulted in changes in salinity in the swamps, and may cause some contamination from pesticide run-off.
Research and conservation: A number of avifaunal surveys have been carried out, and a preliminary study on the productivity of the Bigi Pan area has recently been completed by D. H. Resida. The area will be included in the proposed "Special Management Area" which is being considered for much of the coastal zone of Suriname and which if implemented would allow special protection measures to be imposed in areas of importance for wildlife.

References: Lindeman (1953); Spaans (1975b); Schulz (1976a); Augustinus (1978); Baal (1981); Morrison (1983a & 1983b); de Jong & Spaans (in press).
Source: Ben H. J. de Jong and Arie L. Spaans.
Criteria for inclusion: 123.

Coppenamebank (2)

Location: 5°50'N, 56°10'W; between Burnside and the mouth of the Coppename River, Coronie District.
Area: 15,000 ha.
Altitude: 0-5m.
Province and type: 8.4.1; 02, 05, 06, 07, 08, 09 & 13.
Site description: A stretch of 60 km of coastline west from the estuary of the Coppename River, with broad intertidal mudflats and fringing mangrove swamps bordered inland by a belt of fresh to hypersaline swamps and patches of swamp forest. Large parts of the swamps dry out during the long dry season.
Principal vegetation: Mangrove swamps with *Avicennia germinans*; and marshes with *Cyperus articulatus* and *Typha angustifolia.*
Land tenure: Mainly state owned with some private holdings.
Protection: No habitat protection, but within the Game Protection Area in which hunting is controlled.
Land use: Hunting, fishing, the cultivation of coconuts, and the rearing of bees.
Waterfowl: A very important area for breeding waterfowl, with almost the same species as site 1, but in smaller numbers. Over 10,000 *Egretta caerulea* and up to 10,000 *E. tricolor* have been observed. *Eudocimus ruber* does not breed, but thousands feed in the area. The tidal mudflats are particularly important for passage and wintering Nearctic shorebirds. Peak estimates have included 2,000 *Pluvialis squatarola*, 2,000 *Charadrius semipalmatus*, 1,000 *Numenius phaeopus*, 25,000 *Tringa flavipes*, 5,000 *T. melanoleuca*, over 1,000 *Actitis macularia*, 5,000 *Catoptrophorus semipalmatus*, over 5,000 *Arenaria interpres*, 20,000 *Limnodromus griseus* and 250,000 *Calidris pusilla.* Up to 1,000 *Larus atricilla* and 5,000 *Rynchops niger* have occurred as non-breeding visitors.
Other fauna: Thousands of Orange-winged Parrots *Amazona amazonica* roost in the mangroves. The coastal fringe constitutes an important nursery ground for many fishes and crustaceans.
Threats: Agricultural expansion in adjacent areas has caused changes in the hydrology of the region. There is some contamination with pesticides from agricultural land to the south, and some illegal hunting, particularly of *Eudocimus ruber* and shorebirds.
Research and conservation: A number of bird censuses have been conducted along the coast. The area will be included in the proposed "Special Management Area" which if implemented would allow special protection measures to be imposed.
References: Lindeman (1953); Schulz (1976a); Augustinus (1978); Baal (1981); de Jong & Spaans (in press).
Source: Ben H. J. de Jong and Arie L. Spaans.
Criteria for inclusion: 123.

Coppename River Mouth and the Weg naar Zee area (3)

Location: 5°55'N, 55°30'W; between the mouths of the Coppename River and Suriname River, Saramacca District.
Area: 100,000 ha.
Altitude: 0-5m.
Province and type: 8.4.1; 02, 05, 06, 07, 08, 09, 13, 16 & 18.
Site description: Approximately 100 km of coast between the estuaries of the Coppename and Suriname Rivers, with broad intertidal mudflats and fringing mangrove swamps, bordered

inland by a belt of shallow fresh to hypersaline lagoons and swamps, areas of seasonally flooded grassland, and patches of swamp forest. Large parts of the swamps dry our during the long dry season.

Principal vegetation: Mangrove swamps with *Avicennia germinans*; fresh to brackish marshes with *Cyperus articulatus* and *Typha angustifolia*; and patches of swamp forest.

Land tenure: Mainly state owned with some private holdings.

Protection: The western part is included within the Coppename Mouth Nature Reserve (12,000 ha) established in 1966. The entire area is in the Game Protection Area in which hunting is controlled.

Land use: Hunting, fishing, grazing of livestock and rice-growing. The suburbs of Paramaribo adjoin the eastern extremity of the swamps.

Waterfowl: A very important area for breeding, passage and wintering waterfowl, with almost the same species as sites 1 and 2. Breeding birds include up to 250 pairs of *Nycticorax nycticorax*, 1,500 pairs of *Nyctanassa violacea*, 500 pairs of *Cochlearius cochlearius*, 4,000 pairs of *Egretta caerulea*, 3,000 pairs of *E. tricolor*, and 1,000 pairs of *E. thula.* Up to 4,000 pairs of *Eudocimus ruber* have bred in recent years, with the exceptional total of 6,200 pairs in 1984. Non-breeding visitors include up to 200 *Phoenicopterus ruber*, 1,500 *Larus atricilla* and 10,000 *Rynchops niger.*

The coastal mudflats are particularly important for passage and wintering Nearctic shorebirds. Peak estimates have included 2,500 *Pluvialis squatarola*, 2,500 *Charadrius semipalmatus*, 1,500 *Numenius phaeopus*, 10,000 *Tringa melanoleuca*, 50,000 *T. flavipes*, 10,000 *Catoptrophorus semipalmatus*, over 5,000 *Arenaria interpres*, 50,000 *Limnodromus griseus* and 750,000 *Calidris pusilla.*

Other fauna: Thousands of *Amazona amazonica* roost in the mangroves. The manatee *Trichechus manatus* has been reported, and the coastal fringe constitutes an important nursery ground for many fishes and crustaceans.

Threats: Urbanization and the expansion of agricultural activities are the principal threats. There is some illegal hunting and contamination with pesticides.

Research and conservation: A number of avifaunal surveys and censuses have been carried out, and the Coppename Mouth Nature Reserve is well documented. The entire area will be included in the proposed "Special Management Area" which if implemented would allow special protection measures to be imposed. The area has good potential for nature tourism and conservation education.

References: Teunissen (1972); Schulz (1976a); Augustinus (1978); Spaans (1978a); Baal (1981); de Jong & Spaans (in press).

Source: Ben H. J. de Jong and Arie L. Spaans.

Criteria for inclusion: 123.

Braamspunt, Matapica and Motkreek areas (4)

Location: 5°57'N, 54°55'W; east of the mouth of the Suriname River and north of the lower Commewijne River, Commewijne District.

Area: 65,000 ha.

Altitude: 0-5m.

Province and type: 8.4.1; 02, 05, 06, 07, 08, 09, 12, 16 & 18.

Site description: The estuary of the Suriname River and approximately 50 km of coast to the east, with mud banks, sandy beaches and extensive mangrove swamps, bordered inland by a complex of shallow fresh to hypersaline lagoons and swamps, areas of seasonally inundated grassy marshes, and patches of swamp forest. Large areas of the swamps dry out during the long dry season.

Principal vegetation: Beach vegetation with *Ipomoea pescaprae* and *Canavalia maritima*; mangrove swamps with *Avicennia germinans* and *Rhizophora mangle*; halophytic vegetation with *Sesuvium portulacastrum* and *Batis maritima*; and marshes with *Eleocharis mutata.*

Land tenure: Mainly state owned with some private holdings.

Protection: No habitat protection, but included within the Game Protection Area in which hunting is controlled.

Land use: Hunting, fishing, extraction of sand from inland ridges, and some public recreation around Matapica. Agricultural activities in the area are decreasing.

Waterfowl: An extremely important area for breeding, passage and wintering waterfowl, comparable in importance with site 1 and with almost the same species. Large concentrations of Ardeidae occur, and up to 1,500 pairs of *Egretta alba* and 1,500 pairs of *Ardea cocoi* breed. Other breeding species include *Anhinga anhinga, Ajaia ajaja, Jabiru mycteria, Dendrocygna autumnalis* (over 1,000 pairs), *Anas bahamensis* (over 1,000 pairs), *Charadrius collaris, C. wilsonius* and *Himantopus himantopus. Mycteria americana* has bred (400 pairs in 1970), and up to 2,550 birds have been recorded. Other non-breeding visitors include over 10,000 *Eudocimus ruber*, hundreds of *Gelochelidon nilotica* and *Sterna superciliaris*, and thousands of *Rynchops niger.*

The area is particularly important for passage and wintering Nearctic shorebirds. Peak estimates have included 2,000 *Pluvialis squatarola*, 3,000 *Charadrius semipalmatus*, 1,000 *Numenius phaeopus*, 20,000 *Tringa melanoleuca*, 100,000 *Tringa flavipes*, thousands of *Tringa solitaria*, over 10,000 *Actitis macularia*, 10,000 *Catoptrophorus semipalmatus*, over 5,000 *Arenaria interpres*, 15,000 *Limnodromus griseus*, over 1,000 *Calidris canutus*, over 1,000 *Calidris alba*, 500,000 *Calidris pusilla*, tens of thousands of *Calidris minutilla* and *Calidris fuscicollis*, and over 10,000 *Micropalama himantopus. Anas discors* is common in winter, and over 10,000 have been recorded.

Other fauna: Birds of prey include *Pandion haliaetus* and *Buteogallus aequinoctalis.* The dolphin *Sotalia guianensis* occurs in the Suriname River, and the sea turtles *Chelonia mydas, Dermochelys coriacea* and *Lepidochelys olivacea* nest along the beaches. The estuarine waters and coastal swamps are important nursery grounds for many fishes and crustaceans.

Threats: Heavy hunting pressure poses the only threat at present.

Research and conservation: A number of avifaunal surveys and censuses have been carried out. The area will be included in the proposed "Special Management Area" which if implemented would allow special protection measures to be imposed. The area has good potential for nature tourism and conservation education.

References: Spaans (1975b, 1978a & 1978b); Schulz (1976a); Augustinus (1978); Spaans *et al* (1978); Baal (1981); de Jong & Spaans (in press).

Source: Ben H. J. de Jong and Arie L. Spaans.

Criteria for inclusion: 123.

Wia-Wia and Galibi (5)

Location: 5°55'N, 54°20'W; west of the Marowijne River and north of Moengo, Marowijne District.

Area: 90,000 ha.

Altitude: 0-10m.

Province and type: 8.4.1; 02, 05, 06, 07, 08, 09, 13, 16 & 18.

Site description: The estuary of the River Marowijne and approximately 80 km of coast to the west, with broad intertidal mudflats and fringing mangrove swamps; bordered inland by a belt of shallow fresh to hypersaline lagoons and swamps, areas of seasonally flooded savanna, and swamp forest. Large areas of the swamps dry out during the long dry season.

Principal vegetation: Mangrove swamps with *Avicennia germinans*; swamps with *Eleocharis mutata, Cyperus articulatus, C. giganteus* and *Typha angustifolia*; and swamp forest with *Erythrina glauca.* Mixed xerophytic woodland on sandy ridges.

Land tenure: State owned.

Protection: 36,000 ha are included in the Wia-Wia Nature Reserve established in 1961, and 4,000 ha in the Galibi Reserve established in 1969. Other parts are unprotected.

Land use: Hunting and fishing.

Waterfowl: An extremely important area for breeding, passage and wintering waterfowl, with almost the same species as site 1. Breeding birds include up to 500 pairs of *Nycticorax nycticorax*, 2,000 pairs of *Nyctanassa violacea*, 750 pairs of *Cochlearius cochlearius*, 1,000 pairs of *Bubulcus ibis*, 6,000 pairs of *Egretta caerulea*, 5,000 pairs of *E. tricolor*, 2,000 pairs of *E. thula* and 12,600 pairs of *Eudocimus ruber. Phoenicopterus ruber* is a regular non-breeding visitor, and up to 2,400 have been recorded. Other non-breeding visitors include up to 1,000 *Larus atricilla* and over 10,000 *Rynchops niger.*

The area is extremely important for passage and wintering Nearctic shorebirds. Peak estimates have included 2,000 *Pluvialis squatarola*, 4,000 *Charadrius semipalmatus*, 1,000 *Numenius phaeopus*, 6,000 *Tringa melanoleuca*, 50,000 *T. flavipes*, thousands of *Actitis macularia*, 15,000 *Catoptrophorus semipalmatus*, over 5,000 *Arenaria interpres*, 50,000 *Limnodromus griseus* and 2,000,000 *Calidris pusilla.*

Other fauna: The dolphin *Sotalia guianensis* occurs in the Marowijne River, and *Caiman crocodilus* in the marshes. The beaches at Wia-Wia and Eilanti are important nesting areas for the sea turtles *Chelonia mydas, Dermochelys coriacea* and *Lepidochelys olivacea.*

Threats: None known.

Research and conservation: A number of avifaunal surveys and censuses have been carried out, and the region is of considerable anthropological interest. The area will be included in the proposed "Special Management Area" which if implemented would allow special protection measures to be imposed throughout.

References: Lindeman (1953); Kloos (1971); Spaans (1975b); Schulz (1976a); Augustinus (1978); Baal (1981); Morrison (1983a & 1983b); de Jong & Spaans (in press).

Source: Ben H. J. de Jong and Arie L. Spaans.

Criteria for inclusion: 123.

Nanni Swamp (6)

Location: 5°35'N, 56°55'W; south of Nickerie, Nickerie District.

Area: 270,000 ha.

Altitude: 0-10m

Province and type: 8.4.1; 09, 11, 13, 16, 18 & 19.

Site description: Alluvial plains between the Corantijn and Maratakka Rivers, south of the Nickerie rice-growing area; with slow-flowing rivers, riverine marshes, freshwater swamps, large areas of swamp forest, ombrogenous peat swamps and scattered palms. Large areas of the swamps dry out in the long dry season.

Principal vegetation: Herbaceous swamps with *Cyperus giganteus* and *Typha angustifolia*; ombrogenous peat swamps with *Lagenocarpus guianensis*; swamp forest with *Pterocarpus officinalis, Erythrina glauca, Virola surinamensis* and *Triplaris surinamensis*; and dryland forests with *Carapa procera.*

Land tenure: State owned.

Protection: No habitat protection, but within the Game Protection Area in which there is some control on hunting.

Land use: Impoundments and canals have been constructed to provide water for the irrigation of rice growing areas to the north. Other activities include forestry, burning of peat, and bird catching (principally for *Oryzoborus crassirostris*).

Waterfowl: The waterfowl of the freshwater swamps and swamp forests of the coastal plain of Suriname are poorly known and no quantitative data are available. However, over 75 species have been recorded, and these habitats may be important for many Ardeidae and Rallidae. Resident species characteristic of this zone include *Anhinga anhinga, Botaurus pinnatus, Ixobrychus exilis, Tigrisoma lineatum, Pilherodius pileatus, Cochlearius cochlearius, Mesembrinibis cayennensis, Cairina moschata, Oxyura dominica, Opisthocomus hoazin* (only known from western Suriname), *Aramus guarauna, Aramides axillaris, A. cajanea, Porzana albicollis, P. flaviventer, Laterallus viridis, Porphyrula martinica, Heliornis fulica, Eurypyga helias* and *Jacana jacana.* A wide variety of Nearctic shorebirds have been recorded on migration and in winter in cultivated areas.

Other fauna: The area is rich in Psittacidae, particularly macaws *Ara* spp, and it is one of the few localities in Suriname where *Oryzoborus crassirostris* still occurs in significant numbers. The manatee *Trichechus manatus* and Spectacled Caiman *Caiman crocodilus* also occur.

Threats: The principal threat is the gradual loss of wetland habitat with the expansion of agricultural activities in the north. The effects of water storage and canalization projects on the wetlands are unknown.

Research and conservation: Much of the area remains poorly known. It has considerable archeological interest, and potential for nature tourism and sport fishing.

References: Teunissen (1976, 1978a & 1978b); Vari (1980).

Source: Ben H. J. de Jong and Arie L. Spaans.

Criteria for inclusion: 3a.

Coronie Swamp and surrounding areas (7)

Location: 5°40'N, 56°20'W; south of Burnside and Totness, and east of Wageningen, Districts of Nickerie, Coronie and Saramacca.
Area: 300,000 ha.
Altitude: 0-10m.
Province and type: 8.4.1; 09, 11, 13, 16, 18 & 19.
Site description: Alluvial plains between the Nickerie and Coppename Rivers; with slow-flowing rivers, riverine marshes, extensive freshwater marshes, seasonally flooded grassland, swamp forest, ombrogenous peat swamps and palm forest. Large areas of the marshes dry out in the long dry season.
Principal vegetation: Grassy marshes; ombrogenous peat swamps with *Lagenocarpus guianensis*; swamp forest with *Pterocarpus officinalis* and *Triplaris surinamensis*; and palm swamps with *Mauritia flexuosa.*
Land tenure: Mainly state owned, with some small private holdings.
Protection: No habitat protection, but within the Game Protection Area in which there is some control on hunting.
Land use: In the northern parts, cultivation of rice in low-lying areas and cultivation of peanuts and coconuts on sandy ridges. Elsewhere, forestry, hunting, some fishing, and the capture of birds, particularly *Amazona amazonica*, for the pet trade.
Waterfowl: See description in site 6.
Other fauna: The area is rich in Psittacidae. Mammals include *Hydrochoerus hydrochaeris* and *Tapirus terrestris*, and the Spectacled Caiman *Caiman crocodilus* occurs.
Threats: The principal threats are the expansion of agricultural activities in the north, and a project in the planning stage to construct a water storage basin in Coronie Swamp.
Research and conservation: The area has considerable archeological interest, and potential for nature tourism and sport fishing. A proposal has been made for the establishment of a 32,000 ha nature reserve at Peruvia; this would include all the major plant communities of the region.
References: Spaans (1973); Teunissen (1978a & 1978b).
Source: Ben H. J. de Jong and Arie L. Spaans.
Criteria for inclusion: 3a.

Coesewijne River and surrounding areas (8)

Location: 5°40'N, 55°40'W; south of the Saramacca River, 70 km WSW of Paramaribo, Saramacca District.
Area: 200,000 ha.
Altitude: 5-25m.
Province and type: 8.4.1; 09, 11, 13, 16, 18 & 19.
Site description: Alluvial plains along the Coesewijne River, south of the Saramacca River and east of the Coppename River. Wetland habitats include slow-flowing rivers, riverine marshes, freshwater marshes, seasonally flooded grassland, large areas of swamp forest, palm forest, and ombrogenous peat swamps. Large areas of the marshes dry out in the long dry season.
Principal vegetation: Ombrogenous peat swamps with *Lagenocarpus guianensis*; swamp forest with *Virola surinamensis, Pterocarpus officinalis* and *Triplaris surinamensis*; and palm swamps with *Mauritia flexuosa.*
Land tenure: Mainly state owned, with some small private holdings.
Protection: No habitat protection, but within the Game Protection Area in which there is some control on hunting.
Land use: Some agricultural activities in the northern parts; elsewhere, forestry, hunting and fishing.
Waterfowl: See description in site 6.
Other fauna: The area is rich in Psittacidae, particularly *Ara ararauna.* Mammals include *Pteronura brasiliensis* and *Trichechus manatus*, and the Spectacled Caiman *Caiman crocodilus* occurs.
Threats: Plans exist for the construction of a water storage dam on the Coesewijne River for irrigation of a proposed rice-growing area.

Research and conservation: The area has considerable potential for outdoor recreation, including nature tourism and sport fishing. A proposal has been made for the establishment of a 25,000 ha nature reserve along the Coesewijne River.
References: Teunissen (1978a & 1978b).
Source: Ben H. J. de Jong and Arie L. Spaans.
Criteria for inclusion: 3a.

Area south of Paramaribo (9)

Location: 5°30'N, 55°15'W; 30 km south of Paramaribo, Para District.
Area: 50,000 ha.
Altitude: 5-25m.
Province and type: 8.4.1; 09, 11, 13, 16 & 18.
Site description: Alluvial plains between the Saramacca and Suriname Rivers, with slow-flowing rivers, riverine marshes, and large areas of freshwater swamp, seasonally flooded grassland, and swamp forest. Large areas of the marshes dry out in the long dry season.
Principal vegetation: Marshes with *Eleocharis intersticta*, and swamp forest.
Land tenure: A mixture of state, local government and private ownership, with concessions for mining.
Protection: No habitat protection, but within the Game Protection Area in which there is some control on hunting.
Land use: Bauxite mining; hunting; fishing; agriculture; and forestry.
Waterfowl: See description in site 6.
Other fauna: No information.
Threats: The main threat is the progressive loss of wetland habitat to urban expansion, agriculture and mining activities.
Research and conservation: Because of its proximity to Paramaribo city, the area has excellent potential for outdoor recreation, nature tourism and conservation education.
References: Teunissen (1978a).
Source: Ben H. J. de Jong and Arie L. Spaans.
Criteria for inclusion: 3a.

Commewijne River and surrounding areas (10)

Location: 5°40'N, 54°53'W; 40 km southeast of Paramaribo, Districts of Commewijne and Suriname.
Area: 100,000 ha.
Altitude: 5-25m.
Province and type: 8.4.1; 09, 13, 16 & 18.
Site description: Alluvial plains between the Commewijne and Suriname Rivers, with slow-flowing rivers, freshwater marshes, seasonally flooded grassland, and large areas of swamp forest and palm forest. Large areas of the marshes dry out in the long dry season.
Principal vegetation: Swamp forest with *Virola surinamensis*; and palm forests with *Mauritia flexuosa*.
Land tenure: Mainly state owned, with some small private holdings, particularly along the northern fringe, and concessions for forestry.
Protection: No habitat protection, but parts of the wetland are included within the Game Protection Area in which there is some control on hunting.
Land use: Some agricultural activities in the northern parts; plantations of citrus fruits, coffee, and cacao along the Suriname River.
Waterfowl: See description in site 6.
Other fauna: Mammals include *Pteronura brasiliensis* and *Trichechus manatus*; and the Spectacled Caiman *Caiman crocodilus* is common in Cassewinica creek.
Threats: The main threat may be a gradual loss of wetland habitat to agricultural expansion.

Research and conservation: The area has considerable archeological interest, and potential for nature tourism and general outdoor recreation. A proposal has been made for the establishment of a 35,000 ha nature reserve at Copie in the south. This would also include adjacent areas of savanna. The entire area will be included in the Game Protection Area.
References: Teunissen (1978a & 1978b).
Source: Ben H. J. de Jong and Arie L. Spaans.
Criteria for inclusion: 3a.

River Perica and River Cottica areas (11)

Location: 5°45'N, 54°35'W; west of Moengo, Districts of Commewijne and Marowijne.
Area: 50,000 ha.
Altitude: 5-10m.
Province and type: 8.4.1; 09, 13, 16 & 18.
Site description: Alluvial plains along the Perica and Cottica Rivers, with freshwater swamps, seasonally flooded grassland with scattered shrubs, and swamp forest. Large areas of the marshes dry out in the long dry season.
Principal vegetation: Marshes with scattered *Pterocarpus officinalis* bushes; and swamp forest with *Virola surinamensis* and *Erythrina glauca.*
Land tenure: Mainly state owned, with some small private holdings and concessions for forestry and mining.
Protection: No habitat protection, but parts of the wetland are included within the Game Protection Area, and there is some control of hunting along the main roads and rivers.
Land use: Agriculture; bauxite mining; hunting; and forestry, including plantations.
Waterfowl: Probably similar to other sites in this region (sites 6-10), but very poorly known.
Other fauna: No information.
Threats: Plans for agricultural development may threaten the area in the future.
Research and conservation: The entire area will be included within the Game Protection Area.
References: Teunissen (1978a).
Source: Ben H. J. de Jong and Arie L. Spaans.
Criteria for inclusion: 3a.

Wanekreek and surrounding areas (12)

Location: 5°40'N, 54°10'W; north of Albina and west of Galibi, Marowijne District.
Area: 70,000 ha.
Altitude: 5-12m.
Province and type: 8.4.1; 09, 11, 13, 16 & 18.
Site description: Alluvial plains between the Coermitobo and Marowijne Rivers; with slow-flowing rivers, riverine marshes, freshwater swamps, seasonally flooded cley savannas, large areas of ombrogenous peat swamps, palm swamps and swamp forest. Large parts of the marshes dry out in the long dry season.
Principal vegetation: Ombrogenous peat swamps with *Lagenocarpus guianensis*; palm swamps with *Mauritia flexuosa*; wet savannas; and mixed swamp and dry land forests.
Land tenure: Mainly state owned, with concessions to village communities.
Protection: None.
Land use: Subsistence farming by Indian communities; hunting; and forestry.
Waterfowl: Probably similar to other sites in this region (sites 6-11), but very poorly known. This is one of the few areas in Suriname where *Anhima cornuta* might occur.
Other fauna: The area supports a very large population of *Amazona amazonica*, and is known to be rich in wildlife generally.
Threats: None known.
Research and conservation: The area has some archeological interest, and potential for nature tourism, sport fishing and canoeing. A proposal has been made for the establishment of a 50,000 ha nature reserve at Wanekreek, which would include the southeastern part of the

wetland and some adjacent savanna areas. The entire area will be included in the Game Protection Area.
References: Teunissen (1978a & 1978b).
Source: Ben H. J. de Jong and Arie L. Spaans.
Criteria for inclusion: 3a.

Brokopondo Lake (13)

Location: 4°45'N, 55°05'W; 120 km south of Paramaribo, Brokopondo District.
Area: 160,000 ha.
Altitude: 45m.
Province and type: 8.4.1; 15, 16 & 18.
Site description: A large water storage reservoir constructed in the 1960s, with forested islands and surrounding areas of seasonally flooded savanna and swamp forest. The basin is relatively shallow, and the level fluctuates seasonally by 2-3m. There are large areas of dead trees standing in shallow water around the edges of the dam.
Principal vegetation: In a region of humid tropical forest (mixed evergreen forest) with open savanna areas.
Land tenure: State owned.
Protection: No habitat protection. The shores of the lake are in the Game Protection Area in which hunting is controlled.
Land use: Fishing; and a little recreation.
Waterfowl: The lake is not as yet particularly important for waterfowl, but this may change as it matures. A variety of species have been recorded but no quantitative data are available. Species include *Phalacrocorax olivaceus, Ardea cocoi, Agamia agami, Mesembrinibis cayennensis, Aramides axillaris, A. cajanea, Porphyrula flavirostris, Heliornis fulica, Eurypyga helias* and *Jacana jacana.* Several species of Nearctic shorebirds have been observed in small numbers on migration.
Other fauna: No information.
Threats: None known.
Research and conservation: The development of the lake and its ecosystems are of considerable hydrological and limnological interest, and there is a fisheries potential.
References: Leentvaar (1973 & 1975); Leentvaar *et al* (1976); Van der Heide (1982).
Source: Ben H. J. de Jong and Arie L. Spaans.
Criteria for inclusion: 3b.

Sipaliwini Savanna (14)

Location: 2°00'N, 56°05'W; 425 km south of Paramaribo, on the border with Brazil, Nickerie District.
Area: 100,000 ha.
Altitude: 300-770m.
Province and type: 8.28.10; 09, 10, 13, 16 & 18.
Site description: An open savanna area with several slow-flowing and fast-flowing rivers and streams, some permanent freshwater marshes, large areas of seasonally flooded grassland, and patches of swamp forest.
Principal vegetation: Herbaceous swamps; wet and dry savanna communities; gallery forest along water courses; isolated patches of mixed hydrophytic and xerophytic forests; and rocky outcrops with *Clusia* spp.
Land tenure: State owned.
Protection: The area comprises the Sipaliwini Nature Reserve (100,000 ha) established in 1972.
Land use: Some hunting by the local indians; burning of the grassland; and trapping of song birds, particularly *Oryzoborus crassirostris.*

Waterfowl: No quantitative data are available. Species recorded include *Pilherodiuspileatus, Agamia agami, Mycteria americana, Euxenura maguari, Jabiru mycteria, Mesembrinibis cayennensis, Aramides axillaris, A. cajanea, Porzana albicollis, Laterallus viridis, Porphyrula martinica, Heliornis fulica, Eurypyga helias*, and *Rynchops niger.* A variety of Nearctic shorebirds have been observed on migration.

Other fauna: The area constitutes the northernmost extension of the campos of eastern Brazil, and has an avifauna typical of that region. Mammals include *Myrmecophaga tridactyla* and *Odocoileus virginianus*; and there is an extremely rich fish fauna. The amphibian *Dendrobates azureus* is endemic to the area.

Threats: None known.

Research and conservation: The area is of considerable biogeographical, geological and archeological interest, and has potential for small-scale nature tourism.

References: Van Donselaar (1968); Mees (1968); Hoogmoed (1969a & 1969b); Oldenburger *et al* (1973); Riezebos (1979).

Source: Ben H. J. de Jong and Arie L. Spaans.

Criteria for inclusion: 2b & 3a.

TRINIDAD AND TOBAGO

INTRODUCTION

by **Carol James, Nadra Nathai-Gyan and Geddes Hislop**

Trinidad and Tobago are the most southerly of the Caribbean chain of islands, with Trinidad lying only 12 km from the mainland of South America near the Orinoco Delta, and Tobago 34 km northeast of Trinidad. The twin island nation comprises an area of 5,123km^2, with Trinidad accounting for 4,828km^2. Both islands lie between 10° and 12°-north, and between 60° and 62° west. Trinidad is relatively flat except for three mountain ranges which cross it from east to west; the mountains in the Northern Range are the highest, and attain a maximum elevation of 940m. Numerous rivers drain these upland areas and traverse alluvial plains lying between the ranges. Most end in coastal swamps, marshes or lagoons. In contrast to that of Trinidad, the topography of Tobago is rugged, with a mountain ridge running in a northeast-southwest direction for nearly two-thirds of the length of the island, and rising to 576m. There is a small area of coastal plain in the southwest which contains the only wetland habitat of any significance on the island. There are several small offshore islands, particularly off northwest Trinidad and to the northeast of Tobago.

The climate is humid tropical, with uniformly high temperatures and an annual rainfall in excess of 2,000 mm. There are two main seasons; a long rainy season from late May to December interrupted by a short dry season in late September and October, and a long dry season from January to May. The islands lie on the very edge of the hurricane zone, and rarely experience hurricane or storm force winds.

The total population of Trinidad and Tobago is estimated to be 1,149,300, with 1,106,300 in Trinidad and 43,000 in Tobago. Sixty per cent of this population live in settlements classified as urban, and forecasts indicate that this proportion will increase substantially. More than 90% of Trinidad's population reside and work in the west coastal area and this factor, coupled with the siting of large industrial complexes, manufacturing concerns and large scale agricultural developments, has subjected the area to tremendous pressures.

Land use practices vary with quality of soil, topography and areas of mineral deposits. Economically significant deposits of oil and natural gas exist in the southern lowlands, the Gulf of Paria and off the east coast; and there is a natural asphalt lagoon of 45 ha at La Brea in the south. Approximately 3,000km^2 remain under forest or other natural vegetation; tree crops account for 860km^2, and agriculture, principally the production of sugar cane, and livestock rearing account for a further 830km^2. The manufacturing sector is dominated by oil and sugar refining, and much of the activity related to these is located in west-central and southwest Trinidad.

The most important wetland areas are mangrove swamps, fresh to brackish coastal lagoons, and swamps and swamp forest in the flood plains of the larger rivers and low-lying coastal areas. The Draft National Physical Development Plan of 1978 classified these areas as unsuitable for cultivation and recommended that they be left under indigenous forest cover. The swamps and swamp forests comprise approximately 16,000 ha in Trinidad and 58 ha in Tobago. Reservoirs of significance for waterfowl are located at Navet in the Central Range, at Caroni-Arena in the Northern Range, and at the Pointe-a-Pierre Oil Refinery.

The two most important wetlands for waterfowl are the Caroni and Nariva Swamps. Between them they contain representatives of all the wetland plant communities and waterfowl species found in Trinidad and Tobago. In addition, both swamps are important nursery grounds for marine fisheries, and the Caroni Swamp is particularly important for wildlife related tourism.

Institutional Base for Wetland Conservation and Research

Governmental organizations

Forestry Division, Ministry of Agriculture, Lands and Food Production. The Forestry Division is primarily responsible for the protection and management of Forest Reserves, several of which include important wetland areas. However, with the recent acquisition of a small staff of trained biologists, the Forestry Division has begun to conduct faunal research.

Institute of Marine Affairs. This is an independent research organization set up by the government in 1976 with the assistance of UNDP. Its major role is to conduct research on the marine environment and watershed areas which affect this.

Fisheries Division. This division conducts research on the biology, ecology and exploitation of fishes in all the major wetlands and in the coastal zone of the Gulf of Paria.

Zoological Society of Trinidad and Tobago. This society, set up by an Act of Parliament, is dedicated to the study of the indigenous fauna and is responsible for the Emperior Valley Zoo in Port-of-Spain, which has attracted some 150,000 paying visitors annually since 1982.

Chaguaramas Development Authority. The authority, established by an Act of Parliament, is responsible for management of the entire northwest peninsular of Trinidad. A Park Planner is responsible for research on flora and fauna in the area and for advising the local authorities on conservation matters.

Non-governmental organizations

The University of the West Indies. The Zoology Department and the Department of Biological Sciences have undertaken a number of wetland research projects at Nariva and Caroni Swamps since the late 1960s.

Trinidad Field Naturalist Club. This is the oldest conservation organization in Trinidad dating back to 1891 and with a current membership of 400 persons. Although the predominant role of the Club has always been the education of its members, important issues dealing with the misuse of natural resources or with development proposals which conflict with the principle of wise utilization of resources have, from time to time, been brought successfully to the attention of resource planners.

Pointe-a-Pierre Wildfowl Trust. This private non-profit organization, set up in 1966, manages a wildlife sanctuary and small collection of captive birds, mainly waterfowl, at Pointe-a-Pierre, and conducts studies on indigenous species. Conservation education is given high priority, and the Trust has made considerable progress in increasing the awareness of the general public, particularly school children, to wildlife conservation issues in Trinidad and Tobago.

Asa Wright Nature Centre. This private organization manages a nature reserve in the Arima Valley of the Northern Range. Although no extensive wetland habitat exists in the nature reserve, refuge and feeding are provided for many wetland species normally resident at Caroni Swamp, 5-10 km to the south.

Trinidad Naturalist Magazine. This is a private commercial enterprise which recognized the need to educate the public on natural history and conservation issues, and since its inception in the mid 1970s has published a number of important articles on wetland flora and fauna.

Progress in Wetland Conservation and Research

Several laws of the country affect, either directly or indirectly, the status and protection of wetland habitat and its wildlife. Those of major importance include the Forest Act which provides for the proper management and control of Forest Reserves; the Conservation of Wildlife Act which provides for the declaration of wildlife sanctuaries, protected animals, hunting seasons and a system for the issuance of licenses and permits; and the Marine Areas (Preservation and Enhancement) Act which provides for the protection of flora and fauna in restricted areas. Other legislation covers the exploitation of fishes, crustaceans and sea turtles; the control of oil pollution; the prevention of pollution of fresh waters; and the regulation of irrigation and reclamation schemes. Trinidad became a signatory to the Convention on International Trade in Endangered Species (CITES) in April 1984.

Thirteen Wildlife Sanctuaries exist in Trinidad and Tobago, and two of these are within the major wetlands areas of Caroni and Nariva. In addition, 37 Forest Reserves have been demarcated. The fauna in Wildlife Sanctuaries receive total protection all year round, but in Forest Reserves animals may be hunted during the six months open season. Under a proposed "System of National Parks and other protected areas" prepared by the Forestry Division in conjunction with the Organization of American States, recommendations were made to set aside 61 areas in Trinidad and Tobago for nature conservation and preservation. Management and development plans were prepared for several areas including Caroni Swamp. The Government agreed in principle to the overall system, but no legislation has as yet been enacted. Thus plans to develop Caroni and Nariva Swamps as National Parks, and Fishing Pond, Icacos Basin and Godineau Swamp as Nature Conservation Reserves, have not been implemented.

Over the years, various studies by international consultants on land use of wetlands have been commissioned, but as far as is known, no concrete plans for development have been initiated. The Draft National Physical Development Plan (1978) recognizes the existence of ecologically sensitive areas such as swamps and recommends careful planning for proposed developments.

A considerable amount of research has been conducted on the nation's wetland ecosystems. Some of the principal studies have included the following:

a) A detailed study of the biological associations, hydrology, resource exploitation and potential land use of Nariva Swamp; by the University of the West Indies (Bacon *et al*, 1979).
b) Ecological studies and floral investigations at Caroni Swamp; by Bacon (1970) and Ramcharan (1980) respectively.
c) A socio-economic study of the wetland resources of Caroni Swamp; by Ramdial (1980).
d) A study of the ecological impact of a project to divert the Couva River on the mangrove swamps and fishery in Carli Bay; by the Institute of Marine Affairs (Mutunhu, 1984).
e) Research on the wetlands of Trinidad with special reference to the energetics of mangroves and inventory of the fauna; by the Institute of Marine Affairs (Ramcharan *et al*, 1983).
f) Censuses of *Eudocimus ruber* populations; by the Forestry Division in collaboration with the World Working Group on Storks, Ibises and Spoonbills.

Major Threats to Wetlands and Waterfowl

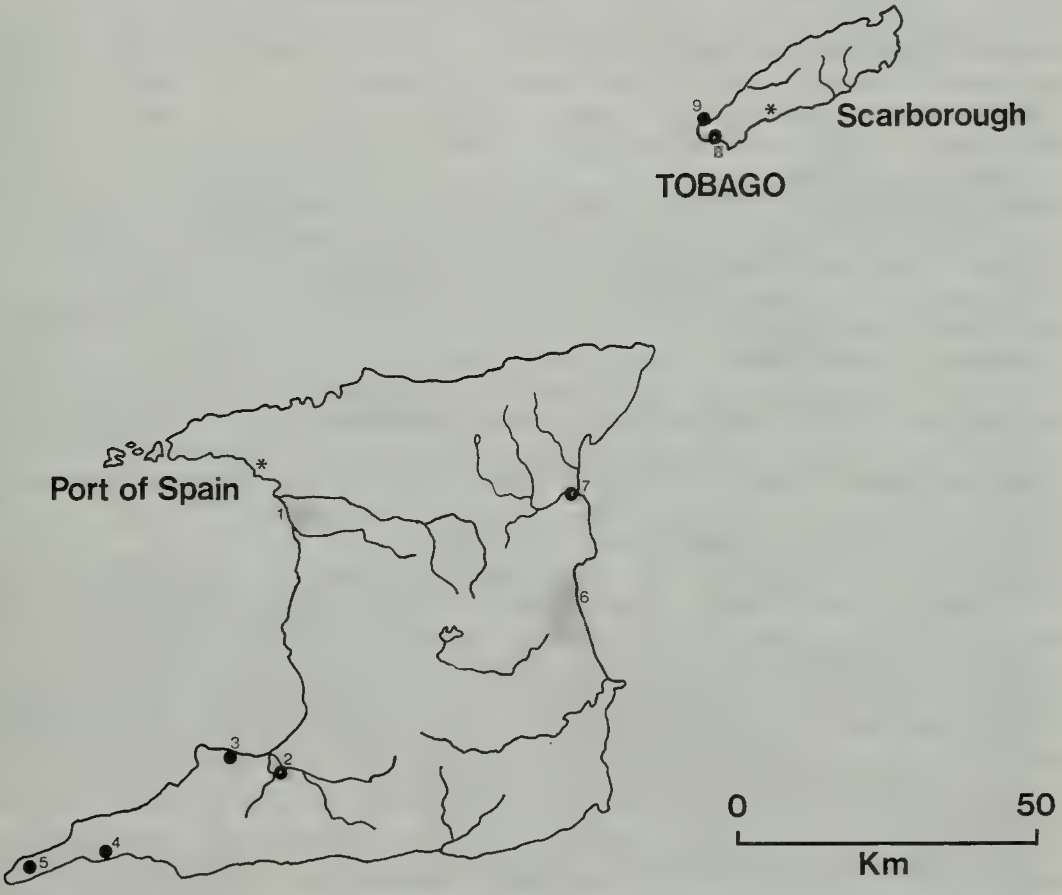
Wetlands in Trinidad and Tobago are under threat from an expanding human population. Pressure for space, pressure for industrial, agricultural and housing developments, and the resulting pollution from such activities are the major threats to all coastal wetlands. Urban and suburban sprawl are particularly severe on the west coast, and have already accounted for the loss of wetlands at Westmoorings, Cocorite, Sealots and Laventille.

Land reclamation for rice cultivation has occurred on the landward side of many coastal wetlands, but in recent years the incursion of salt water at Caroni, Rousillac and South Oropuche has resulted in the abandonment of some areas previously cultivated. Caroni remains under threat because of schemes to dredge channels in the swamp in an attempt to control severe flooding in nearby low-lying agricultural and residential areas. The dredging would seriously affect the hydrology of the swamp, and would offer only a temporary solution to the flooding since the causal factors have not been corrected. These are related to the siltation of water courses resulting from deforestation of hillsides and extensive quarrying activities in the Caroni watershed.

Proposals by private businesses to develop salt water shrimp farming at Nariva and fish ponds at Nariva and Caroni have been received by the Ministry of Agriculture, Lands and Food Production. Advice was sought from the FAO, but their consultant's findings have not as yet been made available. The Forestry Division has registered strong reservations against the total transformation of intact wetland habitat for agricultural development or aquaculture, and has suggested as an alternative the use of degraded habitats such as mangrove swamps close to industrial or residential areas, or abandoned quarry sites.

Inland reservoirs still offer potentially good habitat for most waterfowl because these areas are protected from activities which will reduce the availability or acceptability of water for human consumption.

TRINIDAD & TOBAGO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TRINIDAD

WETLANDS

Site descriptions based on a report prepared by Carol James, Nadra Nathai-Gyan and Geddes Hislop of the Forestry Division (James *et al*, 1984), and data sheets provided by Eugene K. Ramcharan of the Institute of Marine Affairs.

Caroni Swamp (1)

Location: 10°35'N, 61°28'W; 3.5 km southeast of Port of Spain, Trinidad.
Area: 5,611 ha (formerly 14,000-15,000 ha including flood plain).
Altitude: 0-10m.
Province and type: 8.4.1; 03, 07, 08, 09 & 16.
Site description: An estuarine and coastal mangrove system with large brackish to saline lagoons, extensive mangrove swamps, and seasonally inundated brackish marshes and grassland on its landward fringes. The maximum depth of the channels is 9-11m, the level fluctuating with the tides. Seasonal marshes flood to a depth of 1m during the rainy season (June to November). There is an extensive network of ditches throughout the swamp; relicts of drainage projects attempted on several occasions since the early 1930s, but subsequently abandoned. Large areas of the adjacent fresh to brackish marshes have however been reclaimed for agriculture.
Principal vegetation: Mangrove swamps with *Rhizophora mangle*, *Avicennia germinans* and *Laguncularia racemosa* in that order of abundance; marshes with species of *Eleocharis*, *Cyperus*, *Typha*, *Acrostichum*, *Eichhornia*, *Pistia* and *Lemna*.
Land tenure: Mainly state owned; with 3,197 ha in a Forest Reserve, 1,540 ha in State Lands, and 874 ha privately owned.
Protection: Largely within a State Forest Reserve, patrolled daily by Forestry Wardens. 197.6 ha in the north of the swamp have been made into a Bird Sanctuary. A Wildlife Sanctuary of 7,900 ha created in 1936 was decommissioned in 1982. Hunting is prohibited throughout the area during the general close season (1 April to 31 October).
Land use: Intensive fishing and the harvesting of crabs and oysters; hunting from November to March; nature tourism; and agriculture, industrial development, highway construction and dumping of rubbish in peripheral areas.
Waterfowl: A very important area for a variety of waterfowl, and particularly the Scarlet Ibis *Eudocimus ruber*, which formerly nested in large numbers. Unfortunately, because of considerable hunting pressure and disturbance from tourists, the birds have not bred since the 1970s, and numbers feeding and roosting in the swamp have declined to a few thousands (2,450 in early 1984). Other common species include *Pelecanus occidentalis*, *Phalacrocorax olivaceus*, *Bubulcus ibis*, *Butorides striatus*, *Egretta caerulea*, *E. tricolor*, *E. alba*, *Dendrocygna autumnalis*, *Rallus longirostris*, *Gallinula chloropus* and *Larus atricilla*. *Anas discors*, *Ardea herodias* and a variety of Nearctic shorebirds are common on migration and in winter; and *Ajaia ajaja* is a regular non-breeding visitor.
Other fauna: About 140 species of birds have been recorded in the area, and the endemic subspecies of the Straight-billed Woodcreeper *Xiphorhynchus picus altirostris* is apparently confined to the swamp. The Osprey *Pandion haliaetus* is a common winter visitor. The mammalian fauna includes the Silky Anteater *Cyclopes didactylus didactylus* and Crab-eating Racoon *Procyon cancrivorus cancrivorus*; reptiles include *Caiman crocodilus*. The wetland supports a thriving fishery, both offshore and in the swamp. Fishes include *Megalops atlanticus* and species of *Mycteroperca*, *Mugil*, *Lutjanus*, *Caranx*, *Anchoa* and *Hycengraulis*. The crab *Ucides cordatus* is still harvested commercially, but the oyster *Crassostrea rhizophorae*, which was formerly abundant, has been depleted through improper harvesting. Other crab species include *Aratus pisonii* and *Uca* spp.
Threats: The swamp is seriously threatened by a number of factors. There is a serious pollution problem from run-off of fertilizers and pesticides, industrial waste and domestic sewage; peripheral areas are being reclaimed for housing, industrial development, road construction and rubbish tips; there is excessive disturbance from tourists visiting the Sanctuary, excessive hunting during the open season, and a considerable amount of illegal hunting in the close season and in the Bird Sanctuary; the shellfish populations are being overexploited; and there is marine pollution along the coastal fringe.

Research and conservation: The Caroni Swamp has been the focus of a number of activities concerning research, education, recreation and agriculture. In addition to its importance for wildlife, the swamp is of great value as a fish spawning ground, and attracts thousands of tourists each year. A proposal has been made to give National Park status to the entire area, and a management plan has been drawn up, but no action has as yet been taken. The swamp has been nominated as a potential Ramsar Site in anticipation of the Government ratifying that Convention.
References: Bacon (1970, 1971 & 1975); Ramdial (1975 & 1980); Forestry Division & OAS (1979); Thelen & Faizool (1980); IUCN (1982); Lambert (1983); ffrench & Ramcharan (1984).
Source: Carol James, Nadra Nathai-Gyan, Geddes Hislop and Eugene K. Ramcharan.
Criteria for inclusion: 123.

South Oropuche Swamp (2)

Location: 10°12'N, 61°32'W; 8 km southwest of San Fernando, between Freeman Bay and Mosquito Creek, Trinidad.
Area: 5,642 ha.
Altitude: 1-5m.
Province and type: 8.4.1; 02, 07, 08, 13 & 17.
Site description: An estuarine system with a shallow brackish lagoon, up to 1.5m deep, behind a sand bar, tidal mangrove swamps, and fresh to brackish marshes on the landward fringe. A large part of the marshes has been converted into rice paddies. The water level in the marshes fluctuates by 1m, reaching its maximum between June and November.
Principal vegetation: Mangrove swamps with *Avicennia germinans, Laguncularia racemosa* and *Rhizophora mangle*; and marshes with species of *Eleocharis* and *Ipomoea.*
Land tenure: State owned, with large areas leased to rice growers.
Protection: 92 ha are within a Forest Reserve which is patrolled by Game Wardens on a weekly basis. The remainder is unprotected.
Land use: Agriculture, principally rice growing; petroleum exploration; hunting of waterfowl; and fishing.
Waterfowl: An important breeding area for waterfowl, with five mixed colonies of Ardeidae including 500 pairs of *Egretta thula* and 1,000 pairs of *E. alba.* There are also important breeding populations of *Dendrocygna bicolor* and *D. autumnalis. Eudocimus ruber* occurs in small numbers as a non-breeding visitor.
Other fauna: *Pandion haliaetus* occurs in winter, and there is a small population of *Caiman crocodilus.* The wetland is used extensively as a nursery and feeding ground for many species of commercially important fishes, and offshore there is an extensive bank which is the focus of a thriving fishing industry. Crabs include *Cardisoma guanhumi* and *Uca* spp.
Threats: The many threats to the swamp include pollution from agrochemicals and an oil pipeline which runs through the area; increased sedimentation; reclamation for agriculture; squatting by illegal settlers; the dumping of rubbish; coastal erosion; and fires in the dry season.
Research and conservation: Proposals for the conservation of the area have been drawn up by the Institute of Marine Affairs.
References: ffrench & Ramcharan (1984); Ramcharan (1984); Ramcharan *et al* (1983).
Source: Carol James, Nadra Nathai-Gyan, Geddes Hislop and Eugene K. Ramcharan.
Criteria for inclusion: 2c & 3a.

Roussillac Swamp (3)

Location: 10°14'N, 61°36'W; 7 km northeast of Point Fortin, Trinidad.
Area: 496 ha.
Altitude: 0-25m.
Province and type: 8.4.1; 05, 07 & 08.
Site description: A permanent brackish tidal lagoon separated from the sea by a sand bar, and with extensive mangrove swamps. Fluctuations in water level are relatively slight.

Principal vegetation: Mangrove swamps with *Avicennia germinans, Laguncularia racemosa Rhizophora mangle* and *Nymphaea ampla.*
Land tenure: Mainly state owned, with 34 ha in private lands.
Protection: Largely included in a Forest Reserve of 443 ha in which hunting is prohibited, but active protection is limited.
Land use: Agriculture; grazing of livestock; hunting; fishing; and the harvesting of crabs.
Waterfowl: Poorly known. Species recorded include *Jacana jacana* and *Porphyrula martinica.*
Other fauna: The crab *Ucides cordatus* and the catfish *Hoplosternum littorale* form the basis of a local fishery.
Threats: General disturbance from human activities; squatting by illegal settlers; and oil pollution.
Research and conservation: A proposal has been made for the proper management of the area by the Institute of Marine Affairs.
References: Ramcharan *et al* (1983).
Source: Carol James, Nadra Nathai-Gyan and Geddes Hislop.
Criteria for inclusion: 2c & 3a.

Los Blanquizales Swamp (4)

Location: 10°05'N, 61°47'W; 18.5 km WSW of Point Fortin, Trinidad.
Area: 1,085 ha.
Altitude: 0m.
Province and type: 8.4.1; 06, 07 & 08.
Site description: A permanent brackish tidal lagoon, up to 2m deep, with intertidal mudflats, mangrove swamps and brackish marshes.
Principal vegetation: Mangrove swamps; marshes with *Eleocharis intersticta, E. mutata, Acrostichum aureum, Montrichardia arborescens* and *Heliconia psittacorum.* Agricultural land and forests on the landward side.
Land tenure: State owned.
Protection: Protected under the State Lands Act, but the regulations are not properly enforced.
Land use: Agriculture; illegal settlement; and hunting.
Waterfowl: Poorly known. Species recorded include *Phalacrocorax olivaceus, Butorides striatus, Egretta alba, Dendrocygna bicolor, Aramus guaraúna* and *Jacana jacana.*
Other fauna: The parrots *Ara manilata* and *Amazona amazonica* occur in the area. Crabs include *Aratus pisonii* and *Uca* spp.
Threats: General disturbance from human activities; squatting by illegal settlers; agricultural practices causing changes in the hydrology of the area; and pollution from agrochemicals.
Research and conservation: Proper management plans should be developed for the area, and illegal squatting and agricultural encroachment prevented.
References: Ramcharan *et al* (1983).
Source: Carol James, Nadra Nathai-Gyan and Geddes Hislop.
Criteria for inclusion: 3a.

Icacos Basin (5)

Location: 10°04'N, 61°54'W; 30.5 km WSW of Point Fortin, Trinidad.
Area: 330 ha.
Altitude: 0m.
Province and type: 8.4.1; 07 & 08.
Site description: A complex of permanent brackish lagoons, up to 2.5m deep, mangrove swamps and brackish marshes, with relatively stable water levels.
Principal vegetation: Mangrove swamps with *Avicennia germinans, Laguncularia racemosa* and *Rhizophora mangle*; marshes with *Eleocharis* sp, *Acrostichum aureum, Paspalum fasciculatum* and *Heliconia psittacorum.*
Land tenure: State owned.
Protection: Protected under the State Lands Act, and patrolled by Game Wardens.

Land use: A small amount of agriculture, and some grazing of livestock.
Waterfowl: Poorly known. Species recorded include *Phalacrocorax olivaceus, Butorides striatus, Egretta caerulea, E. tricolor, E. thula, E. alba, Dendrocygna bicolor* and *Vanellus chilensis.*
Other fauna: *Caiman crocodilus* occurs.
Threats: There is a small amount of coastal erosion in the area, and overgrazing by domestic livestock.
Research and conservation: Management proposals have been made by the Institute of Marine Affairs. The area has good potential for studies on plant succession.
References: Ramcharan *et al* (1983).
Source: Carol James, Nadra Nathai-Gyan and Geddes Hislop.
Criteria for inclusion: 3a.

Nariva Swamp (6)

Location: 10°23'N, 61°04'W; 16 km SSE of Sangre Grande, on the east coast of Trinidad.
Area: 6,234 ha.
Altitude: 0-10m.
Province and type: 8.4.1; 07, 08, 09, 13, 16 & 18.
Site description: A permanent brackish lagoon with extensive mangrove swamps, separated from the sea by two parallel sand bars, and a large area of fresh to brackish swamps, swamp forest and seasonally flooded marshes. The level of the lagoon is influenced by the tides by way of river channels and possibly subsurface seepage; salinities range from 4-25 p.p.t. The area includes the largest freshwater herbaceous swamp in Trinidad. The seasonal marshes flood to a depth of 1m between June and November, leaving islands of higher ground with humid tropical forest.
Principal vegetation: Beach scrub with *Coccoloba* sp; mangrove swamps with *Rhizophora mangle* and *Avicennia germinans*; permanent herbaceous swamps with *Montrichardia arborescens* and *Cyperus giganteus*; marshes with *Eleocharis mutata, Cyperus giganteus, C. odoratus* and *Phragmites* sp; swamp forest with *Pterocarpus officinalis, Carapa* sp and *Bactris* sp; and islands of humid tropical forest with *Roystonea oleracea, Mauritia setigera* and *Euterpe oleracea.*
Land tenure: Almost entirely state owned, with 6.1 ha under private ownership.
Protection: 1,554 ha of forested high ground jutting out into the swamp are protected in the Bush Bush Game Sanctuary, established in 1968, and 40 ha are included within the Ortoire Nariva Windbelt Forest Reserve. The remainder of the area and thus almost all of the wetland habitat is unprotected.
Land use: Agriculture, grazing of livestock, forestry, hunting, fishing, bird trapping for the pet trade, and recreation.
Waterfowl: An important area for a variety of waterfowl including *Anhinga anhinga*, several Ardeidae, *Dendrocygna autumnalis, Aramus guarauna* and *Jacana jacana.*
Other fauna: Over 170 species of birds have been recorded in the swamp. The Blue and Yellow Macaw *Ara ararauna* formerly occurred, but now appears to have been exterminated as a result of excessive trapping for the pet trade. *Ara manilata* is still fairly numerous. Mammals include the manatee *Trichechus manatus, Cebus albifrons* and *Alouatta seniculus*; and reptiles include *Caiman crocodilus* and *Eunectes murinus.* The wetland supports a large population of the catfish *Hoplosternum littorale*, which forms the basis of a thriving fishery. Crabs include *Cardisoma guanhumi, Ucides cordatus* and *Aratus pisonii*, and the freshwater conch *Pomacea urcens* occurs.
Threats: Many threats have been identified including illegal squatting; the reclamation of land for agriculture and clandestine cultivation of cannabis; illegal grazing of domestic livestock in the Game Sanctuary; exploitation of the forests for timber; overfishing; illegal hunting including the use of gun-traps; and excessive trapping of birds for the pet trade.
Research and conservation: Because of the uniqueness of the physical conditions, the wetland supports a diverse fauna and flora with many species which are found nowhere else in Trinidad. The swamp has significant potential for research, education and recreation, and some studies have already been made on the biological resources. It has been proposed that the entire area be made into a Wildlife Sanctuary or National Park, and that it be designated a Ramsar Site when the Goverment ratifies that Convention.

References: Bacon *et al* 1979; Ramcharan (1980 & 1984); Thelen & Faizool (1980; IUCN (1982); Lambert (1983); ffrench & Ramcharan (1984).
Source: Carol James, Nadra Nathai-Gyan, Geddes Hislop and Eugene K. Ramcharan.
Criteria for inclusion: 123.

North Oropuche Swamp (Fishing Pond) (7)

Location: 10°37'N, 61°03'W; 10 km east of Sangre Grande, Trinidad.
Area: 1,220 ha.
Altitude: 0m.
Province and type: 8.4.1; 02, 07, 08, 09, 16 & 17.
Site description: The estuary of the River Oropuche and a seasonal shallow brackish lagoon, up to 50 cm deep, with mangrove swamps, bordered inland by seasonally inundated grassland and areas of rice cultivation. The lagoon and surrounding marshes dry out completely during the dry season.
Principal vegetation: Mangrove swamps with *Avicennia germinans* and *Rhizophora mangle*; seasonal marshes with *Eleocharis mutata* and *Acrostichum aureum.*
Land tenure: Mainly state owned, with 322 ha in private lands.
Protection: 900 ha are included in the Manzanilla Windbelt Forest Reserve (939 ha); the remainder is unprotected.
Land use: Agriculture, cattle ranching, fishing and the harvesting of crabs.
Waterfowl: Poorly known; species recorded include *Tigrisoma lineatum, Egretta caerulea, E. tricolor, E. thula* and *Jacana jacana.*
Other fauna: The manatee *Trichechus manatus* occurs in the river, and *Eunectes murinus* has been recorded. Fishes include *Hoplosternum littorale, Rivulus hartii* and *Polycentrus schomburgkii*; and crabs include *Aratus pisonii, Cardisoma guanhumi* and *Uca* sp.
Threats: The principal threat is the reclamation of land for agriculture.
Research and conservation: Some research has been conducted in the area by the Forestry Division. The wetland should be declared a Wildlife Sanctuary, at least for the duration of the close season (April to October).
Source: Carol James, Nadra Nathai-Gyan and Geddes Hislop.
Criteria for inclusion: 2a & 3a.

Kilgwyn Swamp (8)

Location: 11°09'N, 60°48'W; 9 km WSW of Scarborough, near the southwestern tip of Tobago.
Area: 12 ha.
Altitude: 0m.
Province and type: 8.17.4; 07 & 08.
Site description: A permanent brackish lagoon with fringing mangrove swamps, separated from the sea by a sand bar.
Principal vegetation: Mangrove swamps with *Rhizophora mangle* and *Laguncularia racemosa*; and halophytic grasses. Coconut plantations inland.
Land tenure: Privately owned.
Protection: No legal protection, but hunting is prohibited and access restricted by the owners.
Land use: Grazing of livestock; dumping of rubbish; fishing; and harvesting of crabs.
Waterfowl: An important area for *Anas bahamensis*, with a breeding population of about 30 birds. Other species present include *Nyctanassa violacea, Butorides striatus* and *Egretta caerulea.*
Other fauna: The crabs *Cardisoma guanhumi, Aratus pisonii* and *Uca* sp.
Threats: Human disturbance; overgrazing by domestic livestock; and infilling with rubbish.
Research and conservation: One of the few wetlands on Tobago, and the only significant land-locked lagoon. The rubbish tip should be relocated, and the area given better protection.
References: Thelen & Faizool (1980).
Source: Carol James, Nadra Nathai-Gyan and Geddes Hislop.
Criteria for inclusion: 2b & 3a.

Buccoo Reef and Bon Accord Lagoon (9)

Location: 11°10'N, 60°51'W; 12 km WSW of Scarborough, at the southwestern tip of Tobago.
Area: 650 ha.
Altitude: 0-2m.
Province and type: 8.17.4; 01, 05, 07 & 08.
Site description: Buccoo Reef is an arc of reef enclosing a sand-bottomed bay, 2m deep, with a single channel connecting to the open sea, and with some fringing mangroves. Bon Accord Lagoon (34 ha) lies at the east end of the reef, between Sheerbird Point and Pigeon Point, and is partly land-locked by a sand bar. There are extensive mangrove swamps along its eastern and southern shores.
Principal vegetation: Mangrove swamps of *Rhizophora mangle* with some *Laguncularia racemosa* on the landward fringes; extensive beds of *Thalassia* sp in the bay. Coconut plantations inland.
Land tenure: Buccoo Reef is state owned; Bon Accord Lagoon is privately owned.
Protection: The reef and surrounding waters were designated as a restricted area in 1966, and have been protected as a strict nature reserve. Bon Accord Lagoon is not legally protected, but the owners prohibit hunting and restrict access.
Land use: Tourism, particularly visits to the reef in glass-bottomed boats; fishing; harvesting of crabs; and livestock grazing.
Waterfowl: Species recorded in the area include *Pelecanus occidentalis, Nycticorax nycticorax, Nyctanassa violacea, Butorides striatus, Egretta caerulea, E. thula* and *Gallinula chloropus*. All have small and vulnerable populations on Tobago.
Other fauna: There is a rich and varied marine fauna associated with the reef, and there are very well developed stands of living coral. The fauna of Bon Accord Lagoon includes the crabs *Cardisoma guanhumi, Aratus pisonii* and *Uca* sp, and the tree oyster *Isognomon alatus*.
Threats: Plans to build a tourist hotel and marina were abandoned because of potential ecological damage to the mangrove ecosystem, but the threat of reclamation for hotel development persists. Bon Accord Lagoon suffers from excessive disturbance from recreation activities, and overgrazing by domestic livestock.
Research and conservation: The area is particularly important for marine life, and presents an ideal opportunity for studies of the relationships between offshore coral reef and mangrove ecosystems. A number of studies have been carried out on the structure of the reefs, sedimentation and water movements, and the value of the mangrove forest in protecting the coastline from hurricane damage is now appreciated. A reduction in the level of grazing along the shores of Bon Accord Lagoon has been proposed.
References: Wood (1964); Goreau (1967); Thelen & Faizool (1980); IUCN (1982).
Source: Carol James, Nadra Nathai-Gyan and Geddes Hislop.
Criteria for inclusion: 2b & 3a.

URUGUAY

INTRODUCTION

by **Raul Vaz-Ferreira**

Uruguay has an area of 176,215km^2 and a population of nearly three million. The country borders on the Atlantic Ocean (220 km of coastline), the Rio de La Plata (460 km) and Rio Uruguay (480 km). There are some 3,500 sq. km of lakes, lagoons and dams, and some 3,500 to 4,000 sq. km of permanent and temporary marshes, the largest being those situated in the east and northeast of the country. Overall, it has been estimated that wetlands make up about 3.6% of the territory of Uruguay.

Of the 400 or so species of birds occurring in Uruguay, 175 (44%) are aquatic or semi-aquatic; these include 28 species of Sphenisciformes and Procellariiformes. There are about 200 species of fishes in the lakes, marshes and rivers; these belong mainly to the Siluriformes and Cypriniformes, and many are of commercial importance. All 36 species of amphibians known from Uruguay inhabit wetlands for at least a part of their life cycle, and several of the reptiles are dependent on wetlands, namely five species of freshwater turtle, three snakes and the caiman *Caiman latirostris*. The latter is now in danger of extinction in Uruguay. Of the mammals associated with wetlands, three are trapped for their fur and constitute important natural resources. These are the La Plata Otter *Lutra platensis*, Coypu *Myocastor coypus* and Capybara *Hydrochoerus hydrochaeris*.

There are over one hundred wetlands in Uruguay which clearly require investigation and which have some scientific and/or economic importance. This inventory considers only twelve of these. Most are relatively large wetlands for which at least some information exists on the avifauna. However, the inventory also includes some sites near Montevideo which would be particularly suitable for research purposes and where it is known that a formerly abundant avifauna has been adversely affected by human activities such as industrial pollution, drainage and exploitation. The inventory has been compiled from existing information, either unpublished material in the possession of the contributors or published material in the literature, and no new information has been sought.

Institutional Base for Wetland Conservation and Research

A large number of institutions are directly or indirectly concerned with conservation in Uruguay, and some thirty official services are involved. Those most directly concerned with wetland conservation are as follows:

Governmental
- Ministerio de Agricultura y Pesca
  - *Direccion de Suelos*: this has carried out surveys of wetlands.
  - *Division Uso y Manejo del Agua.*
  - *Industrias Loberas y Pesqueras del Estado*: this is responsible for the exploitation of fisheries resources in state owned water bodies.
  - *Instituto Nacional de Pesca.*
  - *Direccion de Contralor Legal (Departamento de Fauna)*: this is responsible for ensuring that the hunting regulations and wildlife preservation laws are being enforced. Its activities are assessed by a Commission made up of representatives of all the institutions concerned with these matters.
- Ministerio de Defensa Nacional
  - *Servicio de Parques del Ejercito.*
  - *Servicio de Remonta.*
- Ministerio de Educacion y Cultura
  - *Instituto Nacional para la Preservacion del Medio Ambiente*: this is concerned with general problems relating to the environment and coordinates the activities of its many constitutent bodies in the field of environmental conservation. The Institute is also responsible for CITES and respresents ICBP in Uruguay.

Universidad de la Republica: the Facultad de Agronomia and Facultad de Humanidades y Ciencias provide courses relating to environmental protection, and particularly to the protection of habitats, fauna and flora. The Departamento de Zoologia de Vertebrados in the Facultad de Humanidades y Ciencias periodically holds courses which specialize in the preservation of habitats, particularly wetlands. It also conducts research on aquatic mammals, waterfowl, amphibians and freshwater fishes. The Departamento de Limnologia at the same Faculty carries out limnological investigations and studies of pollution in the basin of the Rio Santa Lucia. The Departamento de Oceanografia coordinates a major programme of marine sciences (Programa de Ciencias del Mar) which includes some topics relating to freshwater systems.

Museo Nacional de Historia Natural: this has published various works on the avifauna of Uruguay.

Ministerio de Transporte y Obras Publicas

Administracion de las Obras Sanitarias del Estado: this is in charge of reservoirs supplying water for domestic consumption, some of which are of biological importance.

Direccion de Hidrografia.

Ministerio de Relaciones Exteriores

Direccion de Intereses Maritimos y Fluviales.

Departamento de Organizaciones Internacionales y Medio Ambiente: this is concerned with conventions on habitat preservation, migratory species, etc.

Municipal Authorities

Non-governmental

Sociedad Zoologica del Uruguay: this holds monthly meetings for the presentation of scientific works, and publishes a bulletin. It has created a conservation group which undertakes projects relating to the conservation of natural habitats.

Centro de Investigacion y Promocion Franciscano y Ecologico: the activities of this Centre include, among other things, the promotion of conservation projects involving wetlands and their aquatic fauna.

Progress in Wetland Conservation and Research

A large number of areas in Uruguay have been given some form of protection. Those under state ownership are known as National Parks, and there are now about one hundred such areas in the country. Protected areas incorporating wetlands or with wetlands in close proximity include the following:

Parque Nacional Arequita (965 ha), Department of Lavalleja.
Parque Nacional de Cabo Polonio (6,324 ha), Department of Rocha.
Parque Nacional de Aguas Dulces (200 ha), Department of Rocha.
Parque Nacional de Santa Teresa (3,288 ha), Department of Rocha; close to extensive marshes and Laguna Negra, and administered by the Servicio de Parques del Ejercito.
Parque Nacional de San Miguel (2,295 ha), Department of Rocha; administered by the Servicio de Parques del Ejercito.

The Islas de Lobos, under the direction of the Industrias Loberas y Pesqueras del Estado, are in effect protected areas, since the only exploitation permitted by this institute is that of the seals, all other wildlife being protected.

The open waters of Laguna de Castillos, an area of about 400 ha, have been declared a reserve, and this is administered by the Ministerio de Agricultura y Pesca.

In 1982, the Consejo de Estado de la Republica Oriental del Uruguay approved the Ramsar Convention, and in May 1984, the instrument of ratification was deposited with UNESCO. Wetlands in eastern Uruguay were designated for inclusion in the Ramsar List of Wetlands of International Importance. The area designated includes the lowlands of the Departments of Cerro Largo, Trienta y Tres and Rocha between 32°00'S and 34°30'S, the adjacent Atlantic coast, the valleys of the water courses which flow into Laguna Merin and the Atlantic, and the nearby marshes.

With regard to research on wetlands and waterfowl, there has been no bird banding programme to date in Uruguay, although foreign banded birds have been recovered in the country. The study of waterfowl began with the present inventory, but several research projects were carried out on other wetland topics before this. These include the following:

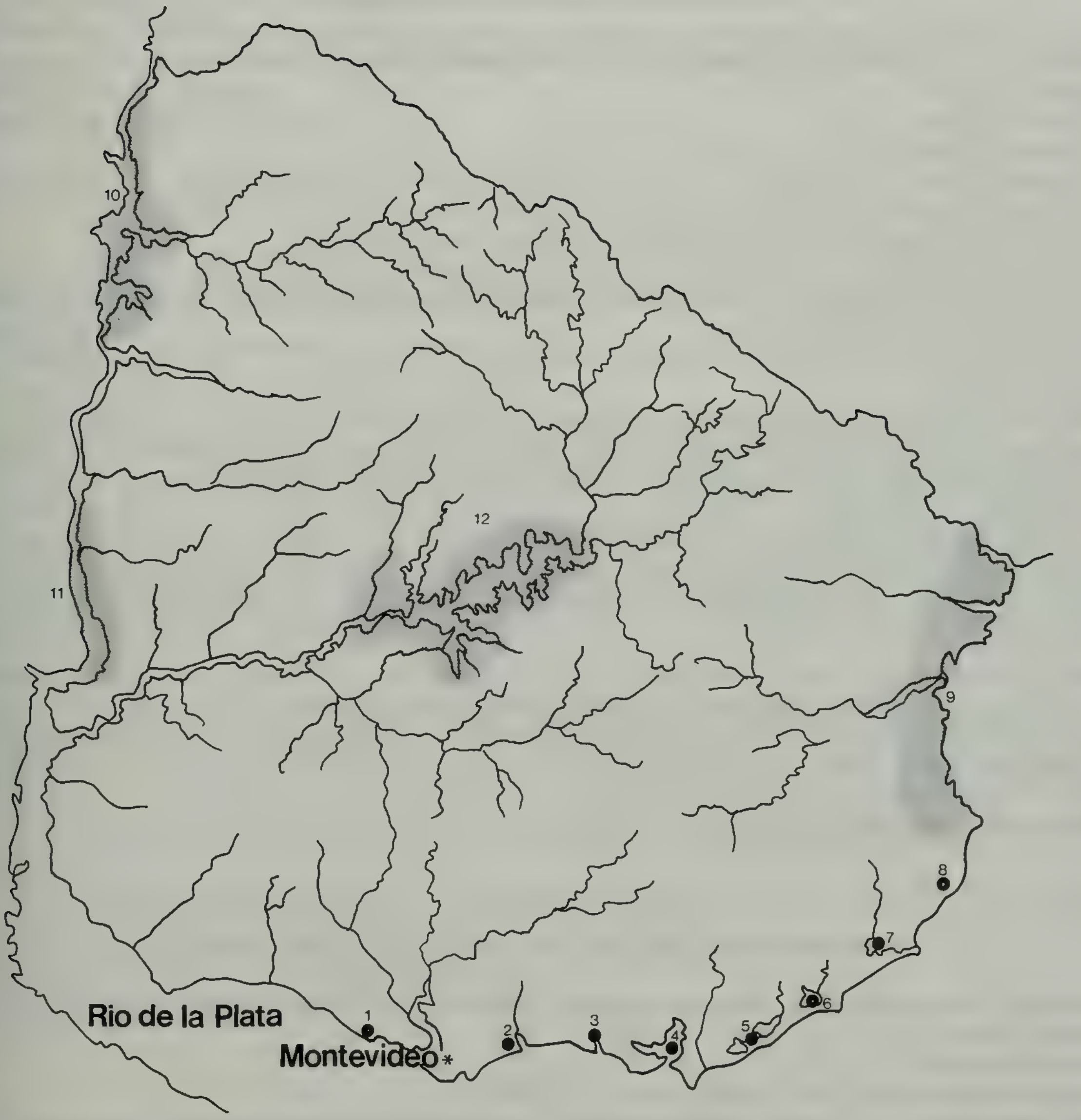
a) A study of changes in the vertebrate fauna, especially waterfowl, at Salto Grande Dam during the flooding of the lake (Palerm, 1977; Vaz-Ferreira *et al*, 1980 & 1983). This work was coordinated by the Departamento de Zoologia Vertebrados at the Facultad de Humanidades y Ciencias, and the Comision Tecnica Mixta de Salto Grande.
b) A study of the productivity and biology of the Coypu *Myocastor coypus* in the marshes of Uruguay, carried out under an agreement between FAO and the Instituto Nacional para la Preservacion del Medio Ambiente (FAO, 1980).
c) An analysis of normal parameters and pollution levels in the basin of the Rio Santa Lucia, carried out by the Departamento de Limnologia at the Facultad de Humandidades y Ciencias, and the Instituto Nacional para la Preservacion del Medio Ambiente.
d) Studies of the biology of *Caiman latirostris*, carried out by the Departamento de Zoologia Vertebrados at the Facultad de Humanidades y Ciencias.
e) Studies of temporary freshwater wetlands and their fauna, carried out by the Departamento de Zoologia Vertebrados at the Facultad de Humanidades y Ciencias.

Major Threats to Wetlands and Waterfowl

The major threats to wetlands and their wildlife in Uruguay are as follows:

a) The drainage of marshes; this has increased in recent years because of the growing interest in converting wetlands into agricultural and pasture land, and particularly in transforming wetlands into areas with controlled flooding suitable for rice-growing.
b) The use of pesticides in rice-growing areas.
c) The killing of waterfowl thought to be responsible for crop damage.
d) Illegal hunting and the slaughter of wildlife by ill-educated individuals.
e) The excessive and highly selective capture of wildlife, including species with very small populations, for both national and foreign zoological collections.

URUGUAY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WETLANDS

Site descriptions based on data sheets prepared by Raul Vaz-Ferreira, Eduin Palerm, Mario D. Huertas, Francisco D. Rilla and Federico Achaval. These authors wish to thank the following for their assistance: Andres Palerm, Enrique Gomez-Haedo, Alfredo Gepp, Daniel Panario, the Instituto Nacional para la Preservacion del Medio Ambiente, and the Direccion de Contralor Legal del Ministerio de Agricultura y Pesca.

Arazati Marshes and Rio Santa Lucia (1)

Location: 34°41'S, 56°43'W; 60 km WNW of Montevideo, San Jose Department.
Area: 90,000 ha.
Altitude: 0-20m.
Province and type: 8.32.11; 02, 05, 07, 09, 11 & 13.
Site description: The estuarine coast of the Rio de la Plata, with saline and freshwater ponds and marshes, sandy beaches and coastal sand dunes; the estuary of the Rio Santa Lucia; and riverine marshes along the lower Rio Santa Lucia.
Principal vegetation: An abundant growth of submergent, floating and emergent aquatic vegetation, with extensive *Scirpus* marshes; sand dune vegetation and plantations of *Pinus* and *Eucalyptus* along the coast.
Land tenure: The coast and Santa Lucia River are state owned (fiscal); the remainder is privately owned.
Protection: None.
Land use: Traditional fishing and sport fishing, hunting, recreation and forestry; cattle ranching, agriculture and some settlements and industry in nearby areas.
Waterfowl: A wide variety of breeding, passage and wintering waterfowl have been recorded, including many Ardeidae, Anatidae and shorebirds.
Other fauna: The area is especially rich in wetland associated passerines including the two reedhaunters *Limnornis curvirostris* and *Limnoctites rectirostris.* The mammals, which are well documented, include *Hydrochoerus, hydrochaeris, Lutreolina crassicaudata* and *Ctenomys torquatus.*
Threats: Pollution, excessive disturbance from recreation and hunting, burning of marsh vegetation, and expansion of forestry activities are all causing problems.
Research and conservation: Inventories of the fauna have been conducted by the Facultad de Humanidades y Ciencias.
Source: Eduin Palerm and Mario D. Huertas.
Criteria for inclusion: 2b & 3a.

Pando and Tropa Vieja Marshes, and adjacent coastal zone (2)

Location: 34°46'S, 55°53'W; 20 km northeast of Montevideo, Canelones Department.
Area: 4,400 ha.
Altitude: 0-4m.
Province and type: 8.32.11; 02, 05, 07, 09, 11, 12 & 13.
Site description: A complex of slow-flowing rivers and riverine marshes; permanent and seasonal freshwater lakes and marshes; and estuarine system of the Arroyo Pando and Arroyo Tropa Vieja, with tidal salt marshes, sandy beaches and coastal sand dunes. There are wide fluctuations in water levels according to local rainfall, and most of the marshes dry out in summer, but the Laguna del Cisne is over 5m deep and permanent.
Principal vegetation: The most abundant aquatic plants are species of *Ludwigia, Canna, Lemna, Pistia, Paspalum, Salvinia* and *Eichhornia*, and the dominant emergents *Eryngium* sp, *Panicum prionitis, Cortaderia selloana, Typha* sp, *Scirpus californicus, S. giganteus, Zizaniopsis* sp and *Juncus* spp. There are thickets with species of *Salix, Baccharis, Acacia* and *Erythrina* in the marshes and along the rivers, and plantations of *Pinus* spp and *Acacia longifolia* in the south.
Land tenure: Mainly privately owned, in small parcels; the coast is state owned.

Protection: None.
Land use: Traditional, sport and commercial fishing; hunting; forestry; beach development for recreation; and extraction of sand and subsequent creation of artificial lagoons.
Waterfowl: A wide variety of breeding, passage and wintering waterfowl occur, including *Podiceps major* (up to 50), *Cygnus melancoryphus* (up to 70), several species of Nearctic shorebirds, and large numbers of gulls and terns Laridae.
Other fauna: The Coypu *Myocastor coypus* occurs, and a wide variety of amphibians have been recorded.
Threats: A general increase in land use, particularly hunting, recreation and forest clearance, continues to destroy the natural habitat. A fire recently destroyed a large part of the woodland and plantations in the south of the area.
Research and conservation: A number of faunal and floral surveys have been conducted by the Department of Vertebrate Zoology at the Facultad de Humanidades y Ciencias.
Source: Mario D. Huertas.
Criteria for inclusion: 2b & 3a.

Marshes of the Arroyo Solis Grande (3)

Location: 34°46'S, 55°26'W; 70 km east of Montevideo, Canelones Department.
Area: 4,500 ha.
Altitude: 0-20m.
Province and type: 8.32.11; 02, 05, 07, 09 & 11.
Site description: A slow-flowing meandering river with associated freshwater marshes, brackish to saline estuarine marshes, tidal salt marshes, coastal sand dunes and sandy beaches. The riverine marshes are partly seasonal, and are much reduced in extent by the end of the dry season.
Principal vegetation: The marsh vegetation includes *Paspalum quadrifarium, Panicum prionitis, Cortaderia selloana* and species of *Scirpus, Zizaniopsis, Juncus, Typha, Eryngium, Eichhornia, Salvinia and Pistia*. Shrubs include *Erythrina cristagalli* and species of *Salix and Acacia*, and there are plantations of *Pinus and Eucalyptus* spp.
Land tenure: Mainly privately owned, in small parcels; the coast is state owned.
Protection: None.
Land use: Traditional, sport and commercial fishing; hunting; recreation; beach development; and forestry. Cattle ranching and agriculture in neighbouring areas.
Waterfowl: A wide variety of breeding, passage and wintering species have been recorded, including many Anatidae, Nearctic shorebirds and Laridae.
Other fauna: The Coypu *Myocastor coypus* occurs and there is a rich amphibian fauna in the area.
Threats: A general increase in land use, particularly drainage for development and illegal hunting, is resulting in the progressive degradation of the area.
Research and conservation: Faunal surveys have been conducted.
Source: Mario D. Huertas and Francisco D. Rilla.
Criteria for inclusion: 2b & 3a.

Arroyo Maldonado and Laguna del Sauce (4)

Location: 34°50'S, 55°04'W; 11 km northwest of Punta del Este, Maldonado Department.
Area: 18,000 ha.
Altitude: 0-2m.
Province and type: 8.32.11; 01, 03, 05, 09, 11 & 12.
Site description: A sea bay with sandy beaches, coastal sand dunes, and two small offshore islands (Islas de Lobos); a slow-flowing river (Arroyo Maldonado) with oxbow lakes and riverine marshes; and the nearby Laguna del Sauce, a permanent shallow freshwater lake (up to 2.1m deep) with surrounding marshes.

Principal vegetation: Typical coastal vegetation including *Spartina ciliata, Panicumracemosum, Androtrychum trygium, Dodonaea viscosa* and *Hydrocotyle* sp. The lake has abundant floating vegetation and marshes of *Scirpus* sp.
Land tenure: A mixture of state and private ownership.
Protection: None.
Land use: Sport hunting and fishing; water sports on Laguna del Sauce; general tourism and recreation; and urban sprawl from Punta del Este and Barra de Maldonado. Plantations of *Pinus* and *Eucalyptus* spp have been established to fix the sand dunes. The seals on Islas de Lobos are periodically exploited for their skins.
Waterfowl: Particularly important for migratory shorebirds and Laridae. Several Nearctic shorebirds are common, including *Pluvialis dominica, Tringa spp, Calidris fuscicollis* and *C. melanotos.* At certain times of the year, large numbers of gulls *Larus* spp and other sea-birds congregate around the seal colonies on the offshore islands.
Other fauna: There are colonies of the sea-lion *Otaria flavescens* and fur seal *Arctocephalus australis* on Islas de Lobos. Other mammals include *Myocastor coypus, Scapteromys tumidus, Holochilus brasiliensis* and *Ctenomys pearsoni.*
Threats: The marsh vegetation is being destroyed by the reclamation of land for development; and domestic animals are being introduced into the area.
Research and conservation: Basic faunal inventories have been conducted.
Source: Francisco D. Rilla.
Criteria for inclusion: 3a.

Laguna Jose Ignacio and Laguna Garzon (5)

Location: 34°49'S, 54°38'W; 25 & 30 km east of San Carlos, Maldonado Department.
Area: Laguna Jose Ignacio 1,800 ha; Laguna Garzon 1,300 ha.
Altitude: 0-5m.
Province and type: 8.32.11; 07.
Site description: Two shallow brackish coastal lagoons and associated marshes separated from the sea by a sand barrier, and periodically connected with the sea. Water levels are subject to wide fluctuations.
Principal vegetation: The aquatic vegetation includes abundant *Eichhornia* sp and *Scirpus* sp. The adjacent coastal sand dunes have been planted with *Pinus pinaster* and *Eucalyptus* spp.
Land tenure: A mixture of state and private ownership.
Protection: None.
Land use: Fishing, hunting, recreation and extraction of sand.
Waterfowl: A wide variety of breeding, passage and wintering species have been recorded, particularly Ardeidae, Threskiornithidae, shorebirds and Laridae. The commoner species include *Phimosus infuscatus* (up to 250), *Plegadis chihi* (up to 1,000), *Calidris fuscicollis and Larus maculipennis.* Up to 200 *Calidris canutus* have been observed at Laguna Jose Ignacio.
Other fauna: Mammals include *Myocastor coypus, Scapteromys tumidus, Holochilus brasiliensis*, and *Ctenomys pearsoni*; and there is a rich reptile and amphibian fauna.
Threats: Tourist development, forest clearance and forest fires are destroying the surrounding areas. Wind-blown sand is gradually filling in the lakes and the aquatic vegetation is spreading and reducing the open water areas.
Research and conservation: Basic faunal and floral surveys have been conducted.
Source: Francisco D. Rilla.
Criteria for inclusion: 2b & 3a.

Laguna de Rocha (6)

Location: 34°40'S, 54°17'W; 17 km west of La Paloma, Rocha Department.
Area: 9,000 ha.
Altitude: 0-5m.
Province and type: 8.32.11; 12, 16 & 19.

Site description: A large shallow coastal lagoon, up to 3m deep, separated from the sea by a sand barrier, with surrounding areas of acidic marshes, peat bogs and seasonally flooded grassland and palm savanna. The water levels fluctuate considerably, and large areas of marsh dry out in summer.

Principal vegetation: Marshes with species of *Scirpus*, *Typha*, and *Juncus*, *Paspalum quadrifarium*, *Panicum prionitis*, *Cortaderia selloana* and *Eichhornia* spp, and other floating aquatics; palm savannas with the palm *Butia capitata* and *Erythrina cristagalli*; thickets of*Salix* and *Acacia*; and plantations of *Pinus* and *Eucalyptus*.

Land tenure: A mixture of state (fiscal) and private ownership.

Protection: None.

Land use: Sport hunting and commercial hunting of coypus, capybara, caiman and rheas; fishing; forestry; rice-growing; and tourist recreation.

Waterfowl: A wide variety of species including *Podiceps major*, *Ajaia ajaja*, *Cygnus melancoryphus* (up to 500) and several Nearctic shorebirds, notably *Calidris fuscicollis*.

Other fauna: Mammals include *Myocastor coypus*, *Hydrochoerus hydrochaeris*, *Scapteromys tumidus*, *Holochilus magnus*, *H. brasiliensis* and *Ctenomys pearsoni*. The caiman *Caiman latirostris* occurs, but is very scarce.

Threats: There is a considerable problem with pesticide run-off from neighbouring rice-fields; and some mammals and birds are being over-exploited.

Research and conservation: Basic faunal and floral surveys have been conducted, but the area has excellent potential for wildlife research, and the establishment of a reserve with appropriate facilities should be encouraged. There is an urgent need for a management plan to permit rational utilization of the wildlife resources of the area.

Source: Francisco D. Rilla.

Criteria for inclusion: 2a, 2b & 3a.

Laguna de Castillos and Arroyo Valizas (7)

Location: 34°20'S, 53°55'W; 12 km southwest of Castillos, Rocha Department.

Area: 10,000 ha.

Altitude: 0-5m.

Province and type: 8.32.11; 09, 12, 13 & 16.

Site description: A permanent shallow brackish lake, up to 5m deep, and marshes, with extensive areas of seasonally flooded grassland and palm savanna. Water levels fluctuate considerably, and large parts of the marshes dry out in summer. At high water levels, the lake overflows into the sea through the Arroyo Valizas.

Principal vegetation: Marshes with abundant *Eichhornia*, *Pistia*, *Scirpus* and *Typha*; seasonally flooded grassland and savannas with *Butia capitata* and *Erythrina cristagalli*; sand dune vegetation nearby.

Land tenure: A mixture of state and private ownership.

Protection: A National Park and Reserve of 8,000 ha were established at Laguna de Castillos in 1966, but these include only the open waters of the lake, and not the surrounding marshes. Some of the marshes and the coastal dunes to the southeast are included within the Costa Atlantica National Monument (14,250 ha) established in 1942. The entire area is part of a large Ramsar site designated in May 1984.

Land use: Sport fishing; hunting, particularly for Coypu and Capybara; and forestry.

Waterfowl: A wide variety of waterfowl occur, including up to 100 *Chauna torquata* and 80 *Cygnus melancoryphus*.

Other fauna: Mammals include *Lutra platensis*, *Myocastor coypus*, *Hydrochoerus hydrochaeris*, *Lutreolina crassicaudata*, *Ctenomys pearsoni* and *Holochilus brasiliensis*.

Threats: There is excessive hunting and fishing, and the nearby woods are being destroyed by fires and indiscriminate felling.

Research and conservation: The National Park and Reserve should be extended to include the surrounding marshes, and the regulations better enforced.

Source: Francisco D. Rilla.

Criteria for inclusion: 2a & 3a.

Laguna Negra and Santa Teresa Marshes (8)

Location: 34°00'S, 53°40'W; 20 km northeast of Castillos, Rocha Department.
Area: 21,500 ha.
Altitude: 0-5m.
Province and type: 8.32.11; 07, 13, 16 & 19.
Site description: A large permanent coastal lagoon, up to 7m deep, with extensive freshwater marshes, peat bogs, and large areas of seasonally flooded grassland and palm savanna. There is very poor drainage in the area and a high accumulation of organic material. At high water levels, Laguna Negra overflows into the Santa Teresa marshes via the Arroyo Los Indios. These marshes then drain into Laguna Merin via the Arroyo San Miguel. There is occasionally some icing in winter.
Principal vegetation: Marshes with species of *Scirpus*, *Typha* and *Eichhornia*; seasonally flooded grassland and savanna with *Butia capitata*, *Erythrina cristagalli* and *Acacia* sp.
Land tenure: A mixture of state (fiscal) and private ownership.
Protection: The nearby Santa Teresa National Park (3,228 ha), established in 1927, includes a strip of coastal scrub, sand dunes and Atlantic coast to the east of Laguna Negra. The lake and all the associated marshes are included in a large Ramsar site designated in May 1984.
Land use: Some hunting and fishing; rice-growing in nearby areas; and tourism and recreation in the Santa Teresa National Park.
Waterfowl: An important area for breeding, passage and wintering waterfowl of a wide range of species. The commoner species include *Egretta thula*, *Plegadis chihi*, *Chauna torquata*, *Anas versicolor*, *Fulica leucoptera*, *Vanellus chilensis* and *Larus maculipennis*.
Other fauna: Mammals include *Lutra platensis*, *Myocastor coypus*, *Hydrochoerus hydrochaeris*, *Scapteromys tumidus*, *Holochilus magnus*, *H. brasiliensis* and *Ozotoceros bezoarticus*.
Threats: Drainage of the wetlands and reclamation of land for agriculture pose the most serious threats. Other problems include excessive hunting and fishing, burning, and disturbance from tourist recreation.
Research and conservation: Now that this wetland has been designated under the Ramsar Convention, reserves should be created and a management plan developed for the area.
Source: Francisco D. Rilla.
Criteria for inclusion: 2a, 2b & 3a.

Laguna Merin and San Miguel Marshes (9)

Location: 32°40'-33°50'S, 53°10'-53°45'W; 70 km east of Treinta y Tres, Rocha and Treinta y Tres Departments.
Area: 350,000 ha.
Altitude: 0-20m.
Province and type: 8.32.11; 07, 09, 13, 16, 17 & 19.
Site description: Laguna Merin is a coastal lagoon, up to 10m deep and 330,000 ha in extent, spanning the Uruguayan/Brazilian border. Approximately 100,000 ha of the lagoon lie in Uruguay. The lagoon margins are mainly hard sand and mud, with little emergent vegetation, but there are very extensive freshwater marshes, shallow freshwater lagoons and impoundments, peat bogs, and areas of seasonally flooded grassland and palm savanna to the west and south. Numerous canals have been dug to facilitate the drainage of the marshes, and large areas are under rice cultivation. The main rivers flowing through the marshes into Laguna Merin are the Tacuari, Olimar and San Luis. Soils are generally peaty with high acidity.
Principal vegetation: Marshes with *Eichhornia*, *Pistia*, *Scirpus californicus*, *S. giganteus*, *Typha* and *Zizaniopsis bonaerensis*; seasonally flooded grassland and savanna with *Butia capitata* and *Erythrina cristagalli*.
Land tenure: A mixture of state (fiscal) and private ownership. 30% of the Biosphere Reserve is state owned.
Protection: No adequate legal protection. 200,000 ha are included within the Bañados del Este Biosphere Reserve established in 1976. The entire area, along with Laguna de Castillos, Laguna Negra and the Santa Teresa Marshes, was designated as a Ramsar site in May 1984.
Land use: Rice-growing in many areas; hunting; utilization of water for irrigation; and some tourist recreation.

Waterfowl: An extremely important area for breeding, passage and wintering waterfowl. A brief survey of a small part of the marshes in October 1983 revealed 53 species of waterfowl including 550 *Egretta thula*, 35 *Euxenura maguari*, at least 25,000 *Plegadis chihi*, 250 *Chauna torquata*, 14 species of Anatidae, three species of *Fulica*, over 300 *Himantopus himantopus*, and very large numbers of *Larus maculipennis*. A concentration of 240 *Heteronetta atricapilla* was particularly noteworthy.

Other fauna: Mammals include *Lutra platensis*, *Myocastor coypus*, *Hydrochoerus hydrochaeris*, *Ctenomys pearsoni* and *Holochilus brasiliensis*.

Threats: The wetlands continue to be drained for cattle ranching, although there is an increasing tendency in the area towards rice-growing and pesticides are being used. Excessive commercial hunting of fur-bearers has resulted in a drastic decline in numbers of the important species, and the industry is dying out. Disturbance from tourist recreation is causing problems in some areas.

Research and conservation: Undoubtedly the most important wetland area for waterfowl and aquatic furbearers in Uruguay. It is to be hoped that with Ramsar designation, steps will be taken to create appropriate reserves and develop an overall wetland conservation strategy for the region.

References: IUCN (1982).

Source: Francisco D. Rilla.

Criteria for inclusion: 123.

Salto Grande Dam (10)

Location: 30°51'S, 57°50'W; on the Rio Uruguay, 14 km north of Salto, Salto and Artigas Departments.

Area: 78,000 ha.

Altitude: 35m.

Province and type: 8.32.11; 09, 11, 15 & 16.

Site description: A large dam on the Rio Uruguay, 120 km long and up to 35.5m deep; completely filled by 1979. The water level fluctuates by up to 6m, exposing large areas of mud at low water, and flooding extensive areas of grassland at high water. There are riverine marshes along the Rio Uruguay as it enters the dam, and marshes in shallow bays.

Principal vegetation: Some floating aquatic vegetation, *Scirpus* marshes, and seasonally flooded grassland. There is still some native forest and scrub in the area, with the endemic *Bambusa tacurusu*.

Land tenure: Most of the land is owned by the Comision Tecnico Mixta de Salto Grande; the remainder is under a mixture of private and municipal ownership.

Protection: No habitat protection. Hunting has been prohibited, but control is inefficient.

Land use: Fishing and pisciculture; hunting of Coypu and Capybara; forestry; cattle and sheep grazing; and cultivation, particularly of sugar cane.

Waterfowl: For a dam, unusually rich in waterfowl, with large numbers of *Podiceps major*, *Phalacrocorax olivaceus*, *Anhinga anhinga*, several species of Ardeidae, *Mycteria americana*, *Phimosus infuscatus*, *Plegadis chihi*, *Chauna torquata*, *Dendrocygna viduata* (tens of thousands), *Amazonetta brasiliensis*, *Aramides ypecaha*, *Fulica armillata*, *Jacana jacana*, *Vanellus chilensis*, *Himantopus himantopus* and *Larus maculipennis*. Eight species of Nearctic shorebirds have been recorded in small numbers.

Other fauna: Approximately 100 species of fishes have been recorded, some of the more important ecologically being the Characoidae, two species of Poecilidae, and one species of Jenynsidae. Species that are exploited commercially include *Salminus maxillosus*, *Hoplias malabaricus*, *Prochilodus platensis*, *Leporinus* spp, and various species of Doradidae. Twenty-two species of amphibians have been recorded, including *Leptodactylus ocellatus*, *L. chaquensis* and *Bufo paracnemis*; and seven aquatic reptiles, including *Caiman latirostris*. Mammals include *Lutra platensis*, *Pteronura brasiliensis*, *Hydrochoerus hydrochaeris*, *Myocastor coypus* and *Ozotoceros bezoarticus*.

Threats: The main threat to the area is run-off of pesticides used in rice-growing in nearby areas. Duck hunting is not excessive, but the Capybara and caiman are heavily persecuted. Forestry operations in the area are destroying the native forests and replacing them with plantations of exotic species.

Research and conservation: Detailed studies of the fauna of the dam were carried out by Vaz-Ferreira and Achaval between 1979 and 1982. A proposal for the establishment of a reserve was put forward some years ago, but no action has been taken to date.
References: Palerm (1977); Vaz-Ferreira *et al* (1980 & 1983).
Source: Raul Vaz-Ferreira and Federico Achaval.
Criteria for inclusion: 123.

Esteros de Farrapos and islands in the Rio Uruguay (11)

Location: 32°50'S, 58°05'W; on the Rio Uruguay between Fray Bentos and San Javier, Rio Negro Department.
Area: 35,000 ha.
Altitude: 5m.
Province and type: 8.32.11; 10, 11 & 16.
Site description: A complex of interconnecting river channels, islands, riverine marshes and oxbow lakes along a 55 km stretch of the Rio Uruguay, with adjacent areas of seasonally flooded grassland. The water level in the river fluctuates considerably according to rainfall, and about 30% of the marshes dry out in the dry season.
Principal vegetation: Marshes with *Scirpus* spp; seasonally flooded grassland; and dense riverine thickets, particularly on the islands, with a very diverse native flora.
Land tenure: Mainly state owned, with some private holdings.
Protection: None.
Land use: Wood-cutting and hunting; cattle ranching and agriculture in the surrounding land.
Waterfowl: A wide variety of species have been recorded, including significant numbers of *Plegadis chihi, Dendrocygna viduata, Aramus guarauna* and *Rynchops niger*.
Other fauna: Mammals include *Lutra platensis, Hydrochoerus hydrochaeris, Myocastor coypus* and *Holochilus magnus*; amphibians include *Leptodactylus ocellatus* and *L. mystacinus*; and reptiles include *Chrysemys dorbignyi*.
Threats: The riverine thickets are being destroyed for fuel; there is a considerable amount of illegal hunting of furbearers and waterfowl; and overgrazing is causing a problem. Much of the area is being considered for conversion into rice fields and other agricultural land.
Research and conservation: The area is primarily important for its very rich and diverse riverine flora which comprises an ecosystem now found almost nowhere else in Uruguay. The area is still relatively inaccessible, and as most of the land is state owned, the establishment of a reserve should not prove difficult. Only preliminary studies have been conducted, and further research is called for.
Source: Mario D. Huertas.
Criteria for inclusion: 2a, 2b & 3a.

Rincon del Bonete Dam and the Rio Negro Marshes (12)

Location: 32°40'S, 56°00'W; 65 km north of Durazno, Departments of Tacuarembo and Durazno.
Area: 150,000 ha.
Altitude: 100m.
Province and type: 8.32.11; 09, 11, 15 & 16.
Site description: A very large dam on the Rio Negro, with numerous small rivers and streams entering along its very indented shoreline; riverine marshes along the Rio Negro; and large areas of seasonally flooded grassland. The water level fluctuates according to control at the dam, and wide expanses of mud are exposed at low water.
Principal vegetation: Relatively little aquatic vegetation in the dam itself, but extensive areas of riverine marsh with *Scirpus* sp, wet grassland, and native woodland.
Land tenure: The dam is state owned; the marshes and surrounding land are privately owned.
Protection: None.
Land use: The dam is used to produce hydroelectricity; also hunting, fishing, ranching and agriculture, and a little forestry.

Waterfowl: Poorly known, but clearly important for *Phalacrocorax olivaceus*.
Other fauna: No information.
Threats: Excessive hunting, disturbance from fishing, and replacement of native woodlands with plantations of exotic species.
Research and conservation: The area is poorly known and requires further study.
Source: Raul Vaz-Ferreira and Mario D. Huertas.
Criteria for inclusion: 0.

VENEZUELA

INTRODUCTION

by **Douglas Figueroa and Andres Eloy Seijas**

Venezuela is situated in northern South America; it has an area of 912,050km^2, a Caribbean coastline of 2,800 km, and a population of almost 14 million.

The country can be divided into four regions: (a) the highlands of the Sierra Nevada de Merida (an extension of the Andes) in the northwest, and the coastal ranges in the north; (b) the lowlands of Maracaibo; (c) the extensive plains of the Llanos de Orinoco; and (d) the highlands of the Guyana Shield in the southeast.

Institutional Base for Wetland Conservation and Research

Governmental
- Ministerio del Ambiente y de los Recursos Naturales Renovables (MARNR).
  - *Direccion General de Informacion e Investigacion del Ambiente* (Direccion de Suelos, Vegetation y Fauna; Servicio Nacional de Fauna Silvestre).
  - *Direccion General Sectorial de Administracion del Ambiente* (Direccion de Asignacion de Recursos; Division de Flora y Fauna).
- Universidad Central de Venezuela (Instituto de Zoologia Tropical).
- Universidad del Zulia.
- Universidad Nacional Experimental de Los Llanos Occidentales "Ezequiel Zamora" (UNELLEZ).
- Universidad "Simon Bolivar".
- Universidad de los Andes.
- Consejo Nacional de Investigaciones Cientificas y Tecnologicas.
- Universidad de Oriente.

Non-governmental
- Fundacion para la Defensa de la Naturaleza (FUDENA).
- Sociedad Venezolana de Ciencias Naturales.
- Fundacion Polar.
- Sociedad Conservacionista Audubon de Venezuela.
- Fundacion Phelps.
- Sociedad de Ciencias Naturales La Salle.

Activities in wildlife conservation in Venezuela are governed by the Protection of Wildlife Law passed in 1970. The Ministerio del Ambiente y de los Recursos Naturales Renovables is the Ministry responsible for research, planning and administration concerning the conservation of wildlife resources. The National Executive, acting through this Ministry, passes resolutions which give legal status to conservation measures such as hunting seasons and hunting regulations.

Progress in Wetland Conservation and Research

At present, there are ten categories of legally protected areas or areas under special control in Venezuela. Some of these, such as Cuare, Chiriguare and Isla Aves Faunal Refuges, were created primarily with a view to protecting wetlands and their waterfowl. However, there are many other protected areas in Venezuela which include large areas of wetland habitat and provide a legal basis for the conservation of these habitats.

The following protected areas include significant wetlands:

- Refugios de Fauna
  - Cuare (11,825 ha), established in 1972.
  - Isla Aves (4 ha), established in 1972.
  - Estero de Chiriguare (44,500 ha), established in 1974.
- Parques Litorales
  - Laguna de los Patos (20 ha), established in 1978.
  - Punta Delgada (25 ha), established in 1978.
- Reservas Forestales
  - Guarapiche (370,000 ha), established in 1961 and 1963.
  - El Caura (5,134,000 ha), established in 1968.
  - Rio Tocuyo (47,640 ha), established in 1969.
- Parques Nacionales
  - Canaima (3,000,000 ha), established in 1962 and 1975.
  - Archipielago Los Roques (225,153 ha), established in 1972.
  - Mochima (94,935 ha), established in 1973.
  - Laguna de la Restinga (10,700 ha), established in 1974.
  - Laguna de Tacarigua (18,400 ha), established in 1974.
  - Aguaro-Guariquito (569,000 ha), established in 1974.
  - Morrocoy (32,090 ha), established in 1974 and 1975.
  - Yapacana (320,000 ha), established in 1978.
  - Duida-Marahuaca (210,000 ha), established in 1978.
  - Peninsula de Paria (37,500 ha), established in 1978.
  - El Tama (139,000 ha), established in 1979.
- Monumentos Nacionales
  - Laguna de Las Marites (3,674 ha), established in 1974.
  - Laguna de Urao (36 ha), established in 1979.
  - Chorreras las Gonzalez (126 ha), established in 1980.
- Reservas Hidraulicas
  - Zona Sur del Lago de Maracaibo (880,000 ha), established in 1974.
- Reservas de Fauna
  - Cienagas de Juan Manuel, Aguas Blancas y Aguas Negras (227,795 ha), established in 1975.
- Lotes Boscosos
  - Rio Guanipa (168,470 ha), established in 1975.

A considerable amount of research has been conducted on the wetlands and waterfowl of Venezuela, particularly by the Servicio Nacional de Fauna Silvestre, the Instituto de Zoologia Tropical at the Universidad Central de Venezuela, the Universidad del Zulia, the Universidad Nacional Experimental de Los Llanos Occidentales "Ezequiel Zamora", the Fundacion para la Defensa de la Naturaleza, and the Sociedad Conservacionista Audubon de Venezuela. Most of the work has focussed on the wetlands of the western and central coastal zones and the llanos, and very little work has been carried out in the Orinoco Delta and at wetlands in Amazonas and Bolivar states. Major research projects recently completed or still on-going include the following:

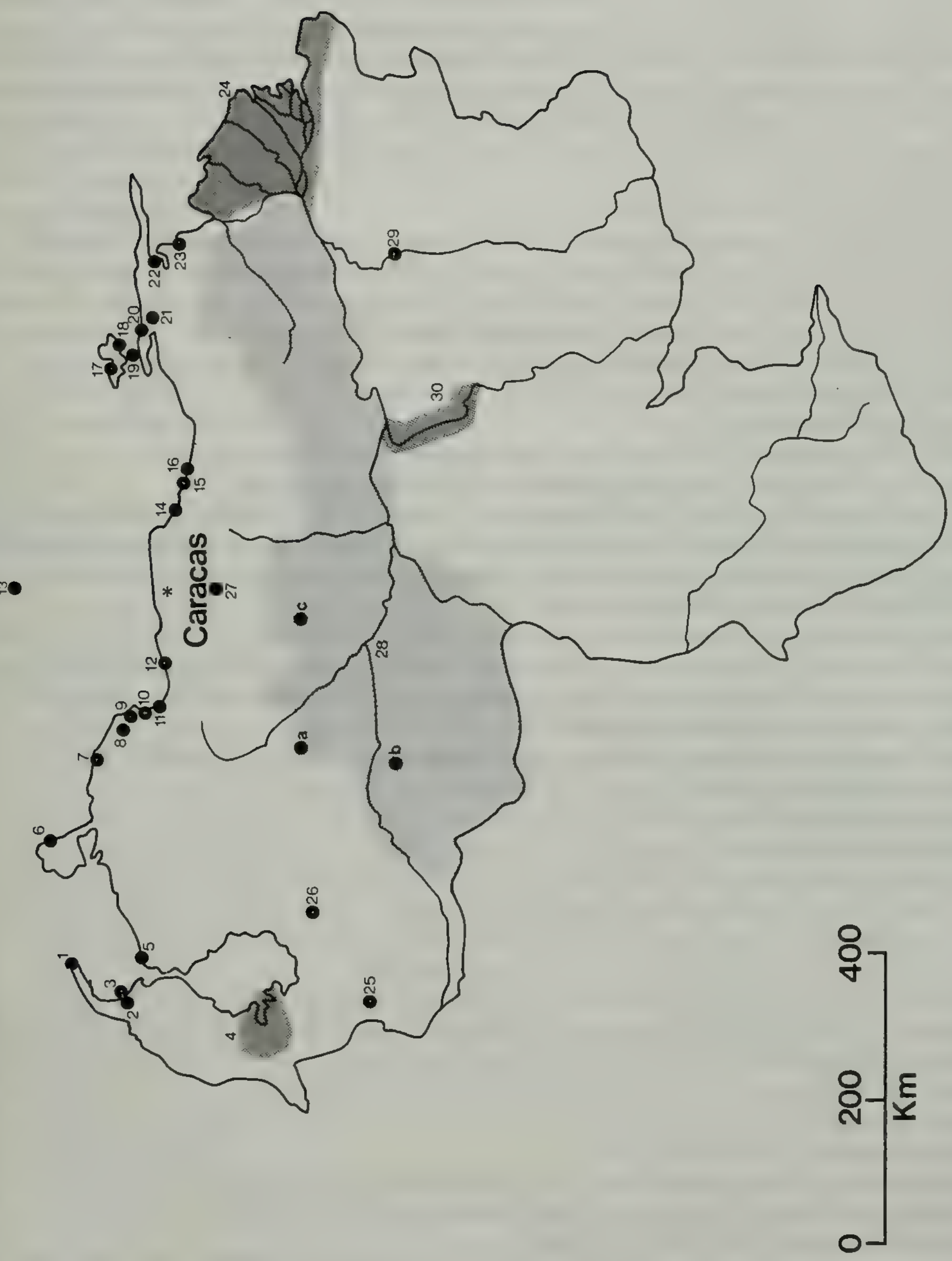
a) Research on the wetlands and waterfowl of the Lago de Maracaibo area, including Cienaga de los Olivitos, by Clark L. Casler and Jose R. Lira of the Universidad del Zulia.
b) Research on the effects of the "modulo" system on wetland fauna and flora in the llanos of Apure, by the Instituto de Zoologia Tropical and James A. Kushlan of the University of Miami.
c) A study of the mangrove ecosystems of Venezuela, by FUDENA.
d) Research on colonially nesting Ardeidae and Threskiornithidae in the western llanos, by C. Ramo and B. Busto of UNELLEZ.
e) Research on Ciconiidae in the llanos, by Betsy Trent Thomas.
f) A study of the status and distribution of *Eudocimus ruber* in Venezuela, and development of a programme for its conservation; part of a much larger international programme coordinated by the World Working Group on Storks, Ibises and Spoonbills, and involving many organizations and individuals in Venezuela.

g) A study of the status, diet and migratory patterns of *Phoenicopterus ruber* and its habitat coastal Venezuela, by Miguel Lentino, the Sociedad Conservacionista Audubon de Venezuela and FUDENA.
h) A study of the Anatidae of Venezuela, by Francisco Gomez Dallmeier.
i) Banding studies of tree-ducks *Dendrocygna* spp in the llanos, by the Servicio Nacional de Fauna Silvestre. The banding programme was initiated in 1981 to study the movements of the birds and effects of hunting on the population. Approximately 15,000 individuals had been banded by the end of 1984.
j) Censuses of shorebirds in coastal Venezuela by the Canadian Wildlife Service, International Shorebird Survey (Manomet), and Servicio Nacional de Fauna Silvestre.
k) Shorebird studies in Sucre, by Raymond McNeil of the University of Montreal.
l) A study of the large terns *Sterna* spp in coastal Venezuela, by the Canadian Wildlife Service and Universidad del Zulia.
m) A study of populations of *Caiman crocodilus* and *Crocodylus acutus* in the north coastal region of Venezuela, by the Servicio Nacional de Fauna Silvestre.
n) Studies of crocodile populations in Bolivar, by the Universidad de Guanare and Florida State Museum.
o) Limnological studies at Lago de Valencia, by W.M. Lewis, Jr. and F.H. Weibezahn.

Threats to Waterfowl Populations

Resident and migratory waterfowl are being affected by a variety of pollutants in different areas. For example, Lago de Valencia is polluted by industrial waste, Lago de Maracaibo by oil spills, and wetlands in irrigated areas by pesticides. The hunting of certain species with low population levels has been prohibited for an indefinite period.

VENEZUELA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WETLANDS

Site descriptions based on data sheets provided by Andres Eloy Seijas of the Servicio Nacional de Fauna Silvestre, Allen B. Altman, Clark Casler, Mary Lou Goodwin, James A. Kushlan, Miguel Lentino, Jose R. Lira, Glenda Medina, Luis Gonzalo Morales, Ramon Rivero and Betsy Trent Thomas; and contributions from Francisco Gomez Dallmeier and Marie Noel de Visscher.

Laguna de Cocinetas (1)

Location: 11°50'N, 71°20'W; on Guajira Peninsula, extreme northwestern Venezuela, Zulia State.
Area: 1,000 ha.
Altitude: 0m.
Province and type: 8.17.4; 07 & 08.
Site description: A permanent shallow saline lagoon with an extensive fringe of mangroves, connected to the sea through a narrow channel. The maximum depth of the lagoon is 2m, and the tidal rise and fall at the mouth about 70 cm. The lagoon is in the process of drying out.
Principal vegetation: Mangrove swamps with *Avicennia germinans, Laguncularia racemosa, Conocarpus erectus* and *Rhizophora mangle*; some beds of *Thalassia* sp. In a region of semi-arid tropical scrub.
Land tenure: State owned.
Protection: Reportedly a protected area, but details of protection unknown.
Land use: A remote area, almost undisturbed by human activities.
Waterfowl: Poorly known; birds observed during a brief visit in March 1983 included many *Pelecanus occidentalis, Egretta tricolor* and *E. alba*, and smaller numbers of *Nyctanassa violacea, Eudocimus ruber, Ajaia ajaja, Dendrocygna autumnalis, Haematopus palliatus* and several species of Nearctic shorebirds.
Other fauna: *Pandion haliaetus* was observed in March 1983.
Threats: There is a gradual loss of mangroves partly as a result of the natural drying out of the lagoon, and partly because of wind blown sand. It has been necessary to dredge the channel to maintain communication with the sea.
Research and conservation: Although reportedly protected, the area is poorly known, and clearly merits further study.
Source: Andres Eloy Seijas.
Criteria for inclusion: 0.

Gran Eneal (2)

Location: 11°10'N, 71°55'W; between Sinamaica and Paraguaipoa, 60 km northwest of Maracaibo, Zulia State.
Area: 15,800 ha.
Altitude: 0-10m.
Province and type: 8.17.4; 07 & 08.
Site description: A large complex of permanent shallow brackish to saline lagoons and marshes with extensive mangrove swamps, inland from a coastal sand dune system. There are slight fluctuations in water level with the tides.
Principal vegetation: Mangrove swamps, and some marshes with *Typha* sp. In a region of semi-arid tropical scrub.
Land tenure: Owned by the local Municipalities.
Protection: None.
Land use: Subsistence hunting and fishing on a small scale; cutting of reeds for the production of handicrafts; cultivation of coconut palms; and tourist recreation. The area is the last refuge of the Paraujano Indians.

Waterfowl: An important area for a wide variety of species, particularly Nearctic shorebirds. Resident species include *Anhinga anhinga, Egretta caerulea, E. tricolor, Mycteria americana, Plegadis falcinellus, Aramus guarauna, Jacana jacana, Charadrius collaris* and *Himantopus himantopus*. Non-breeding visitors include *Egretta rufescens, Ardea herodias, Eudocimus ruber, Phoenicopterus ruber* (up to 100), *Anas discors*, many shorebirds, *Larus atricilla, Gelochelidon nilotica* and *Hydroprogne caspia*. The area is particularly important for wintering *Calidris mauri* and *Micropalama himantopus*.
Other fauna: *Pandion haliaetus* is a winter visitor. The manatee *Trichechus manatus* is reported to occur in the area, and otters *Lutra* sp have been observed.
Threats: There has been some dyke building in the marshes for the cultivation of coconut palms, and there is disturbance from fishermen and tourist recreation, particularly water sports.
Research and conservation: A variety of avifaunal studies have been conducted in the area.
References: Casler & Lira (1979); Lira (1979 & in press); Lira & Casler (1979a & 1979b); Hoogesteijn & Boede (1980); Galue & Nucette (1982); Blokpoel et al (in prep).
Source: Jose R. Lira and Clark Casler.
Criteria for inclusion: 3a.

Caimare Chico (3)

Location: 11°22'-11°08'N, 71°48'-71°57'W; east of Paraguaipoa and Sinamaica, 60 km northwest of Maracaibo, Zulia State.
Area: 16,300 ha.
Altitude: 0-20m.
Province and type: 8.17.4; 05, 06 & 08.
Site description: A large area of intertidal mudflats, sandy beaches and coastal sand dunes, with some mangrove swamps, east of the Gran Eneal marshes (2).
Principal vegetation: Mangrove swamps with *Rhizophora* sp; flats with species of *Batis* and *Sporobolus*; dunes with Cactaceae.
Land tenure: Owned by the local Municipalities.
Protection: No special protection, but the construction of buildings on the beaches is prohibited.
Land use: Commercial fishing, harvesting of snails, and tourist recreation.
Waterfowl: A very important feeding area for many species. The commoner residents include *Pelecanus occidentalis, Phalacrocorax olivaceus, Egretta rufescens, E. thula, Haematopus palliatus* and *Charadrius collaris*. *Phoenicopterus ruber* is a regular non-breeding visitor, and up to 2,500 have been recorded (July 1983). The area is of special importance for wintering Nearctic shorebirds, with large numbers of *Pluvialis squatarola, Catoptrophorus semipalmatus, Arenaria interpres, Calidris canutus* and *C. alba*. A variety of Laridae are common year round, and large numbers of terns, mainly *Sterna maxima* and *Hydroprogne caspia* overwinter.
Other fauna: No information.
Threats: A variety of tourist development projects may have adverse effects on the area in the future; and there is some disturbance from fishermen.
Research and conservation: Several avifaunal investigations have been carried out.
References: Casler & Lira (1979); Lira & Casler (1979a); Blokpoel et al (in prep).
Source: Jose R. Lira and Clark Casler.
Criteria for inclusion: 1b & 3a.

Cienagas de Juan Manuel, Aguas Blancas and Aguas Negras and adjacent areas (4)

Location: 9°20'N, 72°15'W; 100 km southeast of Machiques, Zulia State.
Area: 500,000 ha.
Altitude: 0-20m.
Province and type: 8.3.1; 07, 09, 11, 12, 16 & 18.
Site description: A vast complex of fresh to brackish lagoons and marshes, slow-flowing rivers and riverine marshes, seasonally flooded alluvial plains and patches of swamp forest to the west of Lago de Maracaibo. Water levels reach a maximum of 1.2-2.0m in June-November, and are

at their lowest in January-March. The lagoons closest to Lago de Maracaibo are brackish; those further inland are fresh.
Principal vegetation: Fresh and brackish marshes, seasonally inundated grassland and palm savanna, riverine thickets, gallery forest and swamp forest.
Land tenure: The Wildlife Reserve is state owned.
Protection: The Cienagas de Juan Manuel, Aguas Blancas and Aguas Negras are included within a Wildlife Reserve of 227,795 ha, established in 1975. The remainder is unprotected.
Land use: Ranching, agriculture and some exploitation of timber. Less than 10% of the Wildlife Reserve has been modified by human activities.
Waterfowl: A very important area for resident waterfowl. Over 40 species have been recorded including *Anhinga anhinga, Ixobrychus exilis, Tigrisoma lineatum, Nyctanassa violacea, Pilherodius pileatus, Cochlearius cochlearius*, all three Ciconiidae, *Mesembrinibis cayennensis, Eudocimus ruber, Ajaia ajaja, Anhima cornuta* (common), *Chauna chavaria* (abundant), all three species of *Dendrocygna, Cairina moschata, Aramus guarauna, Rallus nigricans* (the only known locality in Venezuela), *Heliornis fulica* and *Jacana jacana.* The large population of *Chauna chavaria* is particularly noteworthy. This species is restricted in Venezuela to the plains south and west of the Lago de Maracaibo, and reaches its highest densities in the Wildlife Reserve.
Other fauna: The otter *Lutra enudris* and the jaguar *Leo onca* still occur insmall numbers in the Wildlife Reserve.
Threats: Destruction of natural habitat, particularly on the higher ground, for agriculture; drainage of lagoons for pasture land; and some illegal hunting.
Research and conservation: The marshy plains to the south and west of Lago de Maracaibo are unique in Venezuela for their close faunal and floral affinities to the lowlands of the Rio Magdalena in northern Colombia. Some preliminary investigations have been conducted in the area, but further study is required.
References: IUCN (1982); Seijas (1984).
Source: Andres Eloy Seijas.
Criteria for inclusion: 123.

Cienaga de los Olivitos (5)

Location: 10°52'N, 71°25'W; 40 km northeast of Maracaibo, Zulia State.
Area: 33,000 ha.
Altitude: 0-7m.
Province and type: 8.18.4; 02, 05, 07 & 08.
Site description: An estuarine system with sandy beaches and coastal sand dunes (1,885 ha), saline lagoons and salt flats (7,000 ha), brackish lagoons and marshes (20,000 ha), and mangrove swamps (4,115 ha). The wetland includes one of the largest natural salt flats along the entire north coast of South America.
Principal vegetation: Mangrove swamps with *Avicennia germinans, Laguncularia racemosa, Conocarpus erectus* and *Rhizophora mangle.*
Land tenure: No information.
Protection: None.
Land use: Some traditional fishing, and occasional wood-cutting. The area is very remote and virtually unaffected by human activities.
Waterfowl: A very important area for a wide variety of waterfowl; over 45 species have been recorded in preliminary surveys, and another 15 or so probably occur. The commoner resident species and local migrants include *Pelecanus occidentalis* (up to 1,800), *Phalacrocorax olivaceus, Nycticorax nycticorax, Butorides virescens, Egretta caerulea, E. tricolor, E. thula, E. alba, Ardea cocoi, Mycteria americana, Eudocimus albus, E. ruber, Ajaia ajaja, Aramides axillaris and Rynchops niger. Phoenicopterus ruber* is an abundant visitor, and may have bred in the area. Over 4,700 were present in January and July 1983. The commoner Nearctic migrants include *Egretta rufescens, Butorides v. virescens, Anas discors, Pluvialis squatarola, Numenius phaeopus, Tringa melanoleuca, T. flavipes, Actitis macularia, Catoptrophorus semipalmatus, Arenaria interpres, Limnodromus griseus, Calidris canutus* (up to 200 in September), *C. alba, C. mauri, C. minutilla, Larus atricilla*, and various terns *Gelochelidon, Hydroprogne and Sterna* spp. 1,300-1,800 *Hydroprogne caspia and Sterna maxima* were observed in January 1983.

Other fauna: Small numbers of the manatee *Trichechus manatus* and American Crocodile *Crocodylus acutus* occur in the area; both are threatened species in Venezuela.
Threats: A state-owned company for the extraction of salt owns salt ponds to the south, and may wish to expand into the Cienaga de los Olivitos in the future. Also the petroleum industry has expressed interest in exploration for oil in the area. In September 1984, the Military used the area for target practice involving bombing from the air, and apparently the Army plans to use this area for maneuvers in the future .
Research and conservation: A number of avifaunal surveys have been carried out, and Casler and Lira have conducted a detailed study of the area. At the III Congreso Venezolano de la Conservacion, a recommendation was made to the Government that the area be declared a Wildlife Refuge. Under adequate protection, the area might prove suitable as a breeding site for flamingos.
References: Rodriguez (1973); Casler & Lira (1979 & 1983); Lira & Casler (1979a & 1979b); Galue & Nucette (1982); Blokpoel et al (in prep).
Source: Jose R. Lira and Clark Casler.
Criteria for inclusion: 123.

Laguna de Boca de Caño (6)

Location: 12°02'N, 69°50'W; between El Supi and Tiraya, 70 km NNW of Coro, Falcon State.
Area: 50 ha.
Altitude: 0m.
Province and type: 8.17.4; 07 & 08.
Site description: A permanent shallow brackish lagoon, up to 1.5m deep, connected to the sea by a shallow channel, and largely surrounded by mangrove swamps. The lagoon is connected by a system of canals to a salt pan used for the commercial exploitation of salt. There are slight tidal fluctuations in water level.
Principal vegetation: Mangrove swamps with *Avicennia germinans* and *Rhizophora mangle.*
Land tenure: State owned.
Protection: None at present.
Land use: Subsistence fishing and tourist recreation. Commercial exploitation of salt at nearby salt pans.
Waterfowl: Thirty-five species have been observed in preliminary surveys, including *Egretta rufescens, Eudocimus albus, E. ruber, Dendrocygna autumnalis, Rallus longirostris, Charadrius wilsonius, Phaetusa simplex, Rynchops niger* and twelve species of Nearctic shorebirds. *Phoenicopterus ruber* occurs as a non-breeding visitor at the nearby salt pans; 200 were present in January 1983, and 470 in July 1983.
Other fauna: The mangroves are an important roost for the dove *Zenaida auriculata*; an estimated 60,000 birds were using the roost in July 1981. *Pandion haliaetus* is a winter visitor.
Threats: There is increasing disturbance from tourist recreation and salt extraction activities in the surrounding areas.
Research and conservation: The creation of a wildlife refuge is currently under consideration.
References: Ochoa & Ospino (1981); Ospino & Rivero (1981).
Source: Andres Eloy Seijas.
Criteria for inclusion: 3a.

Boca de Hueque and Salinas de Sauca (7)

Location: 11°25'N, 68°57'W; 75 km east of Coro, Falcon State.
Area: Boca de Hueque 5,000 ha; Salinas de Sauca 10,400 ha.
Altitude: 0m.
Province and type: 8.17.4; 02, 07 & 08.
Site description: The estuarine system of the Rio Hueque, with extensive mangrove swamps; and a large area of salt pans, the Salinas de Sauca, to the east.
Principal vegetation: Mangrove swamps dominated by *Avicennia germinans* and *Rhizophora mangle.* In a region of dry tropical woodland.

Land tenure: Thought to be state owned.
Protection: The mangrove area is protected by Presidential decree.
Land use: Cultivation of coconut palms in nearby areas, and extraction of salt at the Salinas de Sauca.
Waterfowl: A wide variety of species have been recorded including *Mycteria americana, Eudocimus ruber, Rallus longirostris, Himantopus himantopus* and a number of Nearctic shorebirds. *Phoenicopterus ruber* occasionally occurs in very large numbers on the Salinas de Sauca; 3,000 were present in October 1981, 2,930 in February 1982 and 540 in January 1983. 3,550 *Anas americana* were observed in February 1982.
Other fauna: No information.
Threats: None known.
Research and conservation: The creation of a wildlife refuge at Boca de Hueque is currently under study.
References: Caballero & Rivero (1981); Morrison et al (1985).
Source: Andres Eloy Seijas.
Criteria for inclusion: 1b & 3a.

The Jatira-Tacarigua Dams (8)

Location: 11°04'N, 68°25'W; near El Tocuyo de la Costa, 30 km NNW of Tucacas, Falcon State.
Area: Jatira 150 ha; Tacarigua 550 ha.
Altitude: 6m.
Province and type: 8.17.4; 15.
Site description: Two small freshwater dams connected by a canal 200m long; Jatira is up to 2m deep and has abundant aquatic vegetation; Tacarigua is up to 6m deep and has less vegetation. The water levels fluctuate considerably with the seasons.
Principal vegetation: Floating beds of *Eichhornia* sp, and patches of *Chara* sp in shallow areas. The surrounding hills are covered with dry, mainly deciduous, scrub (matorral).
Land tenure: State owned.
Protection: Protected by the state.
Land use: The dams supply water to the towns of El Tocuyo de la Costa and Chichiriviche, and are used for irrigation. Sport hunting, principally for *Dendrocygna* spp, is important at Jatira.
Waterfowl: Over fifty species of waterfowl were recorded by Rivero between April 1982 and April 1984. Peak counts included 300 *Egretta alba*, 200 *Mycteria americana*, 80 *Mesembrinibis cayennensis*, 18 *Ajaia ajaja*, 600 *Dendrocygna bicolor*, 2,000 *Dendrocygna autumnalis*, 200 *Anas bahamensis*, 500 *Anas discors*, 300 *Gallinula chloropus*, and 200*Jacana jacana*. Several hundred *Phoenicopterus ruber* were present at most times, and almost 1,400 were recorded in September 1982. Other species included *Ixobrychus involucris, Euxenura maguari, Jabiru mycteria, Phimosus infuscatus, Sarkidiornis melanotos, Oxyura dominica, Porzana flaviventer, Fulica caribaea* and seven species of Nearctic shorebirds.
Other fauna: *Caiman crocodilus* and the turtle *Pseudemys scripta* are abundant, and there is a small population of *Crocodylus acutus*.
Threats: None known.
Research and conservation: Regular avifaunal surveys were carried out by Rivero between April 1982 and April 1984.
Source: Ramon Rivero and Andres Eloy Seijas.
Criteria for inclusion: 1b & 3a.

Wetlands in the Cuare Wildlife Refuge (9)

Location: 10°55'N, 68°20'W; southeast of Chichiriviche, Falcon State.
Area: 8,000 ha.
Altitude: 0m.
Province and type: 8.17.4; 01, 07 & 08.
Site description: A shallow sea bay, up to 2m deep, bordered in most parts by mangrove swamps, and a large area of seasonally flooded brackish lagoons and marshes. The marshes

flood to a depth of about 30 cm during the rainy season, and dry out completely in the dry season (January to March).

Principal vegetation: Mangrove swamps; and flats with halophytic vegetation dominated by *Batis maritima.* In an area of dry thorn and cactus scrub.

Land tenure: State owned.

Protection: Within the Cuare Wildlife Refuge (11,825 ha) established in 1972.

Land use: Some illegal hunting, fishing and harvesting of oysters; tourist recreation; and in recent years, illegal squatting by people from the nearby town of Chichiriviche.

Waterfowl: An extremely important wetland for a wide variety of both breeding species and Nearctic migrants. Over 85 species of waterfowl have been recorded. Peak counts in recent years have included 100 *Podilymbus podiceps, 340 Pelecanus occidentalis, 500 Phalacrocorax olivaceus, 600 Bubulcus ibis, 260 Egretta caerulea, 300 Egretta tricolor, 1,200 Egretta thula, 500 Egretta alba, 280 Mycteria americana, 400 Eudocimus ruber, 100 Plegadis falcinellus, 2,000 Anas americana, 60,000 Anas discors, 400 Anas clypeata, 200 Pluvialis squatarola, 100 Charadrius semipalmatus, 1,000 Tringa melanoleuca, 1,000 Tringa flavipes, 1,200 Calidris pusilla, 800 Calidris mauri, 1,000 Calidris minutilla, 750 Micropalama himantopus, 500 Himantopus himantopus, 55 Chlidonias nigra, 165 Gelochelidon nilotica and 570 Rynchops niger. Phoenicopterus ruber* is a regular non-breeding visitor, often numbering in the thousands. The highest count in recent years was 5,400 in January 1983. Other species of particular note include *Egretta rufescens, Cochlearius cochlearius, Ajaia ajaja, Aramus guarauna, Rallus wetmorei, Aramides axillaris, Porzana flaviventer, Fulica caribaea*, and, in the surrounding areas, *Burhinus bistriatus.*

Other fauna: A few *Crocodylus acutus* occur in the bay.

Threats: The principal threat to the area is the expansion of the town of Chichiriviche: squatters are invading the refuge; large tourist hotels are being constructed nearby; domestic sewage is being dumped directly into the bay; pesticides, particularly D.D.T., have been used extensively in surrounding areas; and a petrochemical plant to the east discharges mercury directly into the sea. The refuge is poorly wardened; there are no game guards and no notices, and there is some illegal hunting. There are many roads in the refuge, and tourist pressure is high.

Research and conservation: The avifauna of the Wildlife Refuge has been well documented, and the flamingo population has received considerable attention. This is clearly one of the most important coastal wetlands in Venezuela, and every effort should be made to ensure that the integrity of the refuge is maintained.

References: Medina (1972); de Boer & Rooth (1976); de Visscher (1976); Seijas et al (1981); IUCN (1982).

Source: Andres Eloy Seijas and Mary Lou Goodwin.

Criteria for inclusion: 123.

Wetlands in Morrocoy National Park (10)

Location: 10°47'-10°49'N, 68°09'-68°22'W; northeast of Tucacas, Falcon State.

Area: 32,090 ha.

Altitude: 0m.

Province and type: 8.17.4; 01, 03, 07 & 08.

Site description: An extensive shallow tidal lagoon with broad fringe of mangrove swamps, numerous mangrove covered islands, and some bare saline flats. The depth varies from a few cm to several metres, and the salinity ranges from 23-35 p.p.t. The water level fluctuates by a few cm with the tides.

Principal vegetation: Mangrove swamps dominated by *Rhizophora mangle*; and marine beds of *Thalassia testudinum.*

Land tenure: State owned.

Protection: Comprises the Morrocoy National Park (32,090 ha) established in 1974.

Land use: Tourism and some illegal fishing.

Waterfowl: An important area for breeding and wintering waterfowl, but few census data are available. Breeding species include *Bubulcus ibis, Egretta tricolor, Egretta thula and Egretta alba.* Up to 100 *Eudocimus ruber* are present year round, and *Euxenura maguari, Jabiru mycteria, Ajaia ajaja* and *Phoenicopterus ruber* occur as non-breeding visitors. Up to 3,000 *Anas discors* and several species of Nearctic shorebirds have been recorded in winter.

Other fauna: There is a large breeding colony of *Fregata magnificens* on an island in the centre of the Park. The Park constitutes an important refuge for marine fauna, and includes coral reef areas. A few *Crocodylus acutus* and sea turtles, principally *Chelonia mydas*, occur in the Park.

Threats: The principal threat is very heavy pressure from tourism, which is uncontrolled and causes considerable disturbance to breeding birds. There are also problems with the dumping of waste and general litter.

Research and conservation: It is imperative that plans be drawn up to reconcile tourism in the Park with the conservation of nature.

References: de Visscher (1976); IUCN (1982).

Source: Andres Eloy Seijas.

Criteria for inclusion: 2b & 3a.

Rio Yaracuy Delta (11)

Location: 10°35'N, 68°17'W; 10 km northwest of Moron, Yaracuy State.

Area: 10,000 ha.

Altitude: 0-6m.

Province and type: 8.18.4; 02, 07, 08, 09 & 12.

Site description: A complex of fresh to brackish lagoons and marshes, mangrove swamps, and seasonally inundated alluvial plains in the delta of the Rio Yaracuy. There is some tidal influence near the mouth of the river.

Principal vegetation: Mangrove swamps; *Pterocarpus* woodland, and marshes with *Typha* sp.

Land tenure: State owned.

Protection: None.

Land use: Water is taken from the delta to supply a large paper mill nearby. There is some subsistence hunting and illegal bird trapping, particularly for species of *Amazona* and *Ara* (Psittacidae). Ranching and agriculture, principally for sugar cane, in the surrounding areas.

Waterfowl: A wide variety of species have been recorded including *Tigrisoma lineatum, Nyctanassa violacea, Cochlearius cochlearius, Phimosus infuscatus, Ajaia ajaja, Anhima cornuta, Dendrocygna autumnalis, Cairina moschata* and *Aramus guarauna*, but no census data are available.

Other fauna: The delta supports an important population of *Crocodylus acutus*, and *Leo onca* and *Tapirus terrestris* occur in the area. There are large populations of Psittacidae, including *Ara chloroptera, A. severa* and *Amazona ochrocephala.*

Threats: Deforestation, drainage of the lagoons, and dredging of the river constitute the main threats.

Research and conservation: The creation of a wildlife refuge in the delta is currently under study.

Source: Ramon Rivero and Andres Eloy Seijas.

Criteria for inclusion: 2a & 3a.

Laguna de Turiamo (12)

Location: 10°28'N, 67°51'W; 25 km east of Puerto Cabello, northern Aragua State.

Area: 1,600 ha.

Altitude: 0-1m.

Province and type: 8.18.4; 07, 08 & 10.

Site description: A permanent shallow brackish coastal lagoon, up to 1m deep, with fringing mangroves, separated from the sea by an old coral barrier 2-3m high. The water level fluctuates by 40-50 cm, reaching a peak in December/January and dropping to a low in April.

Salinities vary from 7-9 p.p.t. in January to 16 p.p.t. in April. The lagoon is fed by several fast-flowing streams from the nearby hills.
Principal vegetation: Mangrove swamps dominated by *Avicennia germinans*; deciduous forest in the nearby hills.
Land tenure: State owned.
Protection: In the northern part of Henri Pittier National Park (107,800 ha) established in 1937. Public use of the Turiamo area is restricted because of the presence of a naval base nearby.
Land use: Subsistence fishing on a very small scale, and some tourism.
Waterfowl: Species recorded include *Pelecanus occidentalis, Nyctanassa violacea, Egretta caerulea, Egretta tricolor, Ardea cocoi, Mycteria americana, Eudocimus ruber, Ajaia ajaja, Anas bahamensis, Himantopus himantopus* (nesting), and a variety of Nearctic shorebirds. A single Southern Pochard *Netta erythrophthalma erythrophthalma* was observed in the area in April 1984.
Other fauna: The lagoon supports a small population of *Crocodylus acutus*.
Threats: None known.
References: Schafer & Phelps (1954).
Source: Andres Eloy Seijas.
Criteria for inclusion: 2a & 3a.

Archipielago Los Roques National Park (13)

Location: 11°42'-12°04'N, 66°30'-67°40'W; an archipelago 130 km off the north-central coast of Venezuela.
Area: 225,153 ha.
Altitude: 0-120m.
Province and type: 8.17.4; 03 & 08.
Site description: An archipelago of numerous small islands and cays with fringing mangroves and extensive coral reefs.
Principal vegetation: Mangrove swamps with *Avicennia germinans* and *Rhizophora mangle*; beds of the sea-grass *Thalassia testudinum* in the surrounding seas.
Land tenure: State owned.
Protection: Constitutes the Archipielago Los Roques National Park (225,153 ha) established in 1972.
Land use: Subsistence fishing. There is a Biological Station on Dos Mosquines Cay.
Waterfowl: The islands support breeding colonies of several species of waterfowl and sea-birds including *Sula leucogaster, Fregata magnificens, Egretta tricolor, Egretta rufescens* and *Sterna albifrons*. *Catoptrophorus semipalmatus* has been found nesting, and small flocks of *Phoenicopterus ruber* occasionally visit the islands.
Other fauna: The surrounding waters support a rich and varied marine fauna including sea turtles.
Threats: None known.
Research and conservation: A considerable amount of research has been conducted on both the marine and the terrestrial fauna of the Park.
References: Phelps & Phelps (1950); Phelps (1975); Yibirin et al (1975); IUCN (1982).
Source: See references.
Criteria for inclusion: 3a.

Laguna de Tacarigua (14)

Location: 10°11'-10°20'N, 65°41'-65°57'W; 30 km southeast of Higuerote, Miranda State.
Area: 12,500 ha.
Altitude: 0-2m.
Province and type: 8.17.4; 05, 07 & 08.
Site description: A permanent shallow saline lagoon, up to 1.5m deep, with extensive mangrove swamps, separated from the sea by a series of sand barriers 25 km long, and connected to the

sea by a tidal channel. The lagoon receives water from several streams and small rivers, notably Rio Guapo and Rio Cupira, and there is some seasonal fluctuation in water level.

Principal vegetation: Mangrove swamps with *Avicennia germinans*, *Laguncularia racemosa*, *Conocarpus erectus* and *Rhizophora mangle*; sand dune vegetation with *Cocos nucifera*; and dry tropical woodland to the south.

Land tenure: State owned.

Protection: Within the Laguna de Tacarigua National Park (18,400 ha) established in 1974.

Land use: Subsistence and commercial fishing; some illegal wood-cutting and hunting; and cattle ranching nearby. The area is of great importance for tourism.

Waterfowl: A wide variety of waterfowl have been recorded including *Pelecanus occidentalis* (breeding), *Anhinga anhinga*, *Nyctanassa violacea*, *Cochlearius cochlearius*, *Egretta caerulea*, *E. tricolor*, *Mycteria americana*, *Eudocimus ruber*, *Ajaia ajaja*, *Rallus longirostris*, *Aramides axillaris*, *Himantopus himantopus*, *Phaetusa simplex*, *Rynchops niger* and several Nearctic shorebirds. The lagoon is an important feeding area for *Phoenicopterus ruber*, and up to 2,050 have been observed, but the birds are much disturbed by tourist activities.

Other fauna: There is an abundant fish fauna, and a small population of *Crocodylus acutus*.

Threats: The main threat is the serious disturbance caused by intensive tourist development in the area and recreation activities, including the use of power boats, on the lagoon. A resort developer recently destroyed a large portion of mangroves adjacent to the park with indiscriminate use of agent orange, and construction activities have affected the mangroves in various channels entering the lagoon. In January 1984, the lagoon was almost devoid of birds.

Research and conservation: The lagoon has been well studied and documented. There is now an urgent need for some control to be exerted on tourist development and related activities in and around the Park.

References: Martin (1949); Waibezahn (1949); MOP (1957); Luengo (1969); Bulhosa (1971); Gamboa et al (1971); Zoppi (1974); Garcia (1977); Rodriguez (1977); Chacartegui & Baldy (1978); INPARQUES (1979a & 1979b); Sutherland (1980); UNESCO (1980 & 1981); Delgado, J. (1981); MARNR (1981b & 1983); Okuda (1981); IUCN (1982); Rodriguez & Alarcon (in prep).

Source: Andres Eloy Seijas.

Criteria for inclusion: 1b, 2a & 3a.

Golfo de Unare (15)

Location: 10°05'N, 65°20'W; 30 km west of Puerto Piritu, Anzoategui State.

Area: 4,750 ha.

Altitude: 0m.

Province and type: 8.17.4; 05, 07 & 08.

Site description: A permanent saline coastal lagoon with mangrove swamps and muddy areas, separated from the sea by a sand barrier. The water level is rather stable.

Principal vegetation: Mangroves.

Land tenure: No information.

Protection: None.

Land use: Fishing, and tourist recreation.

Waterfowl: A very important area for a wide variety of species, particularly *Phoenicopterus ruber* and Nearctic migrants. One of the main feeding areas for *P. ruber* on the Venezuelan coast, with usually at least 400 birds present and occasionally up to 2,000 (e.g in December 1983). Residents and local migrants include up to 250 *Pelecanus occidentalis*, 20,000 *Phalacrocorax olivaceus*, 150 *Egretta tricolor*, 400 *Anas bahamensis*, 50 *Charadrius collaris*, 50 *Himantopus himantopus and 350 Rynchops niger.*

Nearctic migrants include up to 75 *Ardea herodias*, 800 *Anas discors*, 500 *Pluvialis squatarola*, 2,000 *Charadrius semipalmatus*, 30 *Limosa haemastica*, 80 *Tringa melanoleuca*, 300 *Limnodromus griseus*, 150 *Calidris canutus*, 500 *Calidris alba*, 75,000 *Calidris pusilla/mauri*, 2,175 *Larus atricilla* and 400 *Sterna hirundo*, plus smaller numbers of an additional eleven species of shorebirds.

Other fauna: No information.

Threats: The area is under considerable pressure from tourist development, and a main highway has recently been constructed along the edge of the lagoon where the flamingos feed. There is a great deal of disturbance from fishermen and motor boats, and the area is subject to heavy hunting pressure.
Research and conservation: Detailed bird censuses were carried out in 1983 by Altman.
Source: Allen B. Altman and Mary Lou Goodwin.
Criteria for inclusion: 1b & 3a.

Laguna de Piritu (16)

Location: 10°04'N, 65°08'W; west of Puerto Piritu, Anzoategui State.
Area: 2,600 ha.
Altitude: 0m.
Province and type: 8.17.4; 05, 07 & 08.
Site description: A permanent saline coastal lagoon with some mangrove swamps, separated from the sea by a long sand barrier, and with a broad connection to the sea.
Principal vegetation: Mangroves.
Land tenure: No information.
Protection: None.
Land use: Fishing, some livestock grazing and tourist recreation; generally rather little disturbance.
Waterfowl: A very important feeding area for *Phoenicopterus ruber*; 5,000 were present in March 1981, and four censuses between January 1983 and May 1984 gave estimates of between 3,240 and 4,500 birds.
Other fauna: No information.
Threats: Some of the mangroves are being destroyed by cattle, and there is a little disturbance from tourist recreation.
Research and conservation: There is little demographic pressure in the area, and with some restrictions on grazing and controls on recreation activities, this lagoon might be preserved as one of the least spoiled coastal wetlands in central Venezuela.
References: Morrison et al (1985).
Source: Mary Lou Goodwin.
Criteria for inclusion: 1b & 3a.

Laguna de la Restinga (17)

Location: 10°57'N, 64°05'W; on the central plain of Isla de Margarita, Nueva Esparta State.
Area: 1,600 ha.
Altitude: 0m.
Province and type: 8.17.4; 05, 07 & 08.
Site description: A permanent shallow saline lagoon with over 1,000 ha of mangrove swamps and surrounding saline flats, separated from the sea by a sand barrier, and connected via a tidal channel.
Principal vegetation: Mangrove swamps with *Avicennia germinans, Laguncularia racemosa, Conocarpus erectus* and *Rhizophora mangle*; halophytic vegetation with *Sporobolus virginicus* and *Batis maritima*; surrounding areas with arid tropical scrub.
Land tenure: State owned.
Protection: Within the Laguna de la Restinga National Park (10,700 ha) established in 1974.
Land use: Tourist recreation and some wood-cutting.
Waterfowl: A variety of Ciconiiformes have been reported, and the area is known to be important for migratory shorebirds, but no census data are available. 155 *Phoenicopterus ruber* were observed in January 1983.
Other fauna: There is a very rich invertebrate fauna associated with the roots of *Rhizophora mangle* including economically important species such as *Crassostrea* sp, and also a diverse fish fauna including *Hippocampus* sp.

Threats: There is a considerable amount of disturbance from recreation activities, notably motor-cycling; hundreds of birds are killed each year by the high tension power lines running along the sand barrier; and there is some pollution, illegal hunting, and cutting of trees.
Research and conservation: A variety of general faunal and floral investigations have been carried out in the Park.
References: Fernandez et al (1940); Yepez (1963); Scura & Carpi (1981); IUCN (1982).
Source: Andres Eloy Seijas.
Criteria for inclusion: 3a.

Laguna de las Marites (18)

Location: 10°55'N, 63°57'W; on the southeast coastal plain of Isla de Margarita, Nueva Esparta State.
Area: 2,000 ha.
Altitude: 0m.
Province and type: 8.17.4; 07 & 08.
Site description: A permanent shallow saline lagoon with 900 ha of open water, 940 ha of mangrove swamps, and surrounding saline flats; connected to the sea by a narrow channel.
Principal vegetation: Mangrove swamps with *Avicennia germinans, Laguncularia racemosa, Conocarpus erectus* and *Rhizophora mangle*; surrounding plains with dry thorn scrub.
Land tenure: State owned.
Protection: Within the Laguna de las Marites Natural Monument (3,674 ha) established in 1974.
Land use: No information.
Waterfowl: Species mentioned in the literature include *Nycticorax nycticorax, Eudocimus ruber, Ajaia ajaja* and many species of shorebirds. Species recorded during a short visit in June 1981 include *Pelecanus occidentalis* (breeding), *Phalacrocorax olivaceus, Butorides striatus, Egretta caerulea, E. tricolor, E. alba* and *Ardea herodias.*
Other fauna: There is a small population of the American Crocodile *Crocodylus acutus* (the only population on Isla de Margarita), and a great variety of fishes and marine invertebrate life in the lagoon.
Threats: Some illegal hunting of *Crocodylus acutus.*
Research and conservation: General faunal and floral investigations have been carried out in the Natural Monument.
References: Fernandez et al (1940); Yepez (1963); MARNR (1980a & 1981a); IUCN (1982).
Source: Andres Eloy Seijas.
Criteria for inclusion: 2a & 3a.

Salina de Coche (19)

Location: 10°47'N, 63°59'W; on Isla de Coche, Nueva Esparta State.
Area: 450 ha.
Altitude: 0m.
Province and type: 8.17.4; 05 & 07.
Site description: A permanent hypersaline lagoon, up to 30 cm deep, surrounded by sandy beaches.
Principal vegetation: Only some algae.
Land tenure: A mixture of state and private ownership.
Protection: None.
Land use: Commercial exploitation of salt.
Waterfowl: Known to be a very important area for migratory shorebirds, but few data are available. Resident species in the area include *Pelecanus occidentalis, Phalacrocorax olivaceus, Egretta tricolor, Haematopus palliatus* and *Larus atricilla*; migrants include many shorebirds and *Chlidonias nigra, Sterna albifrons* and *Rynchops niger.*
Other fauna: No information.
Threats: Disturbance from the exploitation of salt, a nearby airport, and urban development.

References: Yepez (1963); Lentino (1983b).
Source: Miguel Lentino.
Criteria for inclusion: 3a.

Laguna de Chacopata (20)

Location: 10°40'N, 63°47'W; on the Araya Peninsula, 45 km ENE of Cumana, Sucre State.
Area: 700 ha.
Altitude: 0m.
Province and type: 8.17.4; 01 & 08.
Site description: A shallow sea bay with fringing mangrove swamps.
Principal vegetation: Mangroves.
Land tenure: State owned.
Protection: None.
Land use: Fishing, harvesting of molluscs and crustaceans, and tourist recreation.
Waterfowl: A breeding area for *Pelecanus occidentalis* and a very important feeding area for both local and Nearctic migrants, and particularly *Phoenicopterus ruber*. Four censuses of *P. ruber* between January 1983 and May 1984 ranged from a low of 890 in May 1984 to a high of 2,000 in February 1983. Other species present year round include *Mycteria americana, Eudocimus ruber* and *Ajaia ajaja*. Migrants include *Egretta rufescens, Ardea herodias, Anas discors*, 15 species of Nearctic shorebirds, and a variety of gulls and terns Laridae.
Other fauna: According to local reports, sea turtles are common on the nearby beaches of the Araya Peninsula.
Threats: Overfishing and uncontrolled hunting; disturbance from tourism; and mortality of birds, including flamingos, striking high tension power lines at a nearby electricity plant. There is a proposal to construct a bridge to Isla de Margarita and this could seriously affect the area, but the project has been suspended because of economic difficulties.
References: Medina & Rengel (1979); Lentino (1983a).
Source: Miguel Lentino and Glenda Medina.
Criteria for inclusion: 1b & 3a.

Laguna de Campona (21)

Location: 10°32'N, 63°35'W; on the isthmus of the Araya Peninsula, 75 km east of Cumana, Sucre State.
Area: 800 ha.
Altitude: 20m.
Province and type: 8.17.4; 12.
Site description: A permanent freshwater lake and marshes, subject to slight seasonal fluctuations in water level.
Principal vegetation: Aquatic vegetation includes *Montrichardia* sp and *Scirpus* sp. In a region of dry tropical forest.
Land tenure: A mixture of private and state ownership.
Protection: No legal protection, but the owners (UDO) protect the area to some extent.
Land use: Fishing; ranching and agriculture in surrounding areas.
Waterfowl: Little information available; species known to occur include *Anhinga anhinga, Nycticorax nycticorax, Cochlearius cochlearius, Egretta caerulea, Eudocimus ruber, Ajaia ajaja, Aramus guarauna, Jacana jacana* and *Vanellus chilensis*. *Anas discors* occurs in winter.
Other fauna: No information.
Threats: The lake is being reduced in size because of the utilization of its waters in various irrigation projects; there is some contamination with pesticides; and cattle trample the marsh vegetation.
Research and conservation: The lake merits further study as it constitutes one of the few freshwater lakes in the coastal lowlands of northern Venezuela.

References: Medina (1979b); Lentino (1983a).
Source: Miguel Lentino and Glenda Medina.
Criteria for inclusion: 3a.

Golfo de Paria (22)

Location: 10°20'N, 62°50'W; 70 km NNE of Maturin, Sucre State.
Area: 45,000 ha.
Altitude: 0-20m.
Province and type: 8.4.1; 01, 02, 06, 08, 09, 16 & 18.
Site description: A shallow sea bay and estuarine system of several slow-flowing rivers, with extensive intertidal mudflats and mangrove swamps, areas of seasonally inundated grassland and palm savanna, and swamp forest. The tidal rise and fall exceeds one metre.
Principal vegetation: Mangrove swamps, particularly well developed; swampy grassland; palm savanna; and swamp forest.
Land tenure: A mixture of state and municipal ownership.
Protection: A large part of the mangroves are included within the Guarapiche Forest Reserve (370,000 ha), established in 1961 and 1963, but the mangroves are not being exploited at this site.
Land use: Commercial and subsistence fishing.
Waterfowl: Little information available, but the extensive intertidal mudflats are known to be a very important feeding area for *Eudocimus ruber*, and presumably numerous shorebirds. Resident species include *Pelecanus occidentalis, Anhinga anhinga, Ardea cocoi, Cairina moschata, Aramides axillaris* and *Eurypyga helias*. *Anas discors* occurs in winter.
Other fauna: The manatee *Trichechus manatus* has been recorded.
Threats: There are no immediate threats to the area.
Research and conservation: Very little work seems to have been conducted in the area.
Source: Andres Eloy Seijas.
Criteria for inclusion: 3a.

Rio San Juan Estuary (23)

Location: 10°05'N, 62°50'W; 50 km northeast of Maturin, on the border between Sucre and Monagas States.
Area: 100,000 ha.
Altitude: 0-25m.
Province and type: 8.4.1; 02, 08, 09, 16 & 18.
Site description: The estuarine system of the Rio San Juan, with extensive mangrove forests along the river channels, fresh to brackish swamps, permanently and seasonally inundated savannas, and swamp forest. Tidal fluctuations are unusually high.
Principal vegetation: Very well developed mangrove forest with trees up to 40m high, including pure stands of *Rhizophora* spp, *Avicennia germinans* and *Laguncularia racemosa*, and mixed stands of all these; swamps with *Mauritia* palms; permanently flooded savannas with *Acrostichum* sp; and swamp forest with a relatively high heterogeneity.
Land tenure: State owned.
Protection: Within the Guarapiche Forest Reserve (370,000 ha) established in 1961 and 1963. Forestry exploitation is permitted through concessions to private companies.
Land use: The company Tamavenca has a concession for commercial exploitation of the mangrove forests.
Waterfowl: Little information available, but known to be an important breeding area for a variety of species, and one of the most important sites for *Eudocimus ruber* on the Venezuelan coast. Resident species include *Pelecanus occidentalis, Anhinga anhinga, Tigrisoma lineatum, Nyctanassa violacea, Syrigma sibilatrix, Mycteria americana, Cairina moschata, Aramides axillaris* and *Eurypyga helias*.
Other fauna: The Osprey *Pandion haliaetus* occurs as a winter visitor. Mammals include *Leo onca, Trichechus manatus* and *Tapirus terrestris*.

Threats: Excessive exploitation of the forestry resources and oil pollution could become serious problems in the future.
Research and conservation: There should be better control over forestry activities so that these do not affect the integrity of the region as a whole.
References: Bermudez (1960); Tamavenca (1971); Canales & Zelwer (1978).
Source: Andres Eloy Seijas, Ramon Rivero and Glenda Medina.
Criteria for inclusion: 1b, 2a, 2b & 3a.

The Orinoco Delta (24)

Location: 8°25'-10°00'N, 60°20'-62°30'W; in the Territorio Federal Delta Amacuro.
Area: 3,000,000 ha.
Altitude: 0-20m.
Province and type: 8.4.1; 02, 08, 09, 11, 16 & 18.
Site description: The delta of the Orinoco River: a vast mosaic of mangrove swamps, permanent fresh to brackish swamps with groves of palms, seasonally flooded grassland and palm savanna, swamp forest, and higher ground with tropical evergreen forest, all interwoven with an intricate network of river channels. Water levels fluctuate with the flood cycle of the Rio Orinoco, and salinities vary from fresh in the west to brackish in the extreme east.
Principal vegetation: Mangrove swamps with *Avicennia* sp, *Conocarpus erectus*, *Laguncularia racemosa* and *Rhizophora mangle*; marshes with *Paspalum repens*, *Eichhornia azurea*, *Montrichardia arborescens*, *Gynerium sagittatum* and species of *Ipomoea*, *Heliconia* and *Calathea*; and palm swamps and savannas with the palms *Manicaria saccifera*, *Astrocaryum aculeatum* and *Mauritia flexuosa*.
Land tenure: Mainly state owned.
Protection: None.
Land use: The human population is very low throughout the area, and agricultural activities are of little significance. The indigenous Warao Indians hunt, fish and harvest crustaceans for local consumption. Forestry is relatively important: two companies exploit the palm *Euterpe* sp on a commercial basis, and there is some exploitation of mangroves.
Waterfowl: Little information is available, but it is clear that the delta is of very great importance for a wide variety of resident and migratory species. During aerial surveys in July 1983 and July 1984, several large breeding colonies of *Egretta alba*, *Ardea cocoi* and *Eudocimus ruber* were located. 450 pairs of *E. ruber* were found in 1983, and 1,280 in 1984. Over 90 *Ajaia ajaja* were also observed in 1983. During an aerial survey in January/February 1982, 85,000 shorebirds were observed; most were small *Calidris* sandpipers, the bulk probably *C. pusilla*. A ground survey of some mangrove areas in July 1983 recorded over 25 species of waterfowl including *Pelecanus occidentalis*, *Anhinga anhinga*, *Tigrisoma lineatum*, *Nyctanassa violacea*, *Egretta tricolor*, *Dendrocygna autumnalis*, *Cairina moschata*, *Opisthocomus hoazin*, *Eurypyga helias*, *Phaetusa simplex* and *Sterna superciliaris*. Large breeding colonies of *P. occidentalis* were located along the northern end of the delta in February 1982.
Other fauna: The manatee *Trichechus manatus* is known to occur in the delta.
Threats: There is uncontrolled exploitation of the mangroves in some areas, and illegal exploitation of wildlife both for food and for the animal trade. The main threat however is the drilling for oil just off the coast, which could result in a serious oil pollution problem.
Research and conservation: Because of its size and the difficulties of access, the Orinoco Delta remains one of the least well known regions of Venezuela. At the same time, it remains one of the least disturbed.
References: Beebe (1909); Zahl (1950); Spaans (1975a); Medina (1979a); Morrison (1983a); Novoa (1983); Morrison et al (1985).
Source: Glenda Medina, Ramon Rivero and Andres Eloy Seijas.
Criteria for inclusion: 123.

Paramo de Tama (25)

Location: 7°26'N, 72°21'W; 22 km southeast of Las Delicias, Tachira State.
Area: 10,000 ha.
Altitude: 2,600-3,250m.
Province and type: 8.33.12; 10, 13 & 19.
Site description: An area of wet paramo in the high Andes of western Venezuela, with permanent freshwater ponds and marshes, peat bogs, wet grassland and fast-flowing mountain streams.
Principal vegetation: Paramo vegetation with *Espeletia* spp, *Chusquea spencei*, *Puya* sp, bromeliads and ferns; very humid elfin forest and montane cloud forest in surrounding areas.
Land tenure: Mainly state owned, with some private holdings.
Protection: Within El Tama National Park (139,000 ha) established in 1979.
Land use: Livestock grazing; agriculture, particularly coffee growing, elsewhere in the Park.
Waterfowl: *Merganetta armata colombiana* occurs on the streams, and *Gallinago nobilis* in the bogs. The latter is known in Venezuela only from this area.
Other fauna: A wide variety of Andean animal and plant species occur in Venezuela only in this region. Ten species of birds are known only from the Park, and a further eleven are confined to the Park and neighbouring areas of Tachira and Zulia States.
Threats: Overgrazing of the peat bogs by domestic livestock.
Research and conservation: One of the few significant high Andean wetland areas in Venezuela; relatively well studied and documented.
References: Ewel et al (1976); Mondolfi (1976); Parrish (1976); Vuilleumier & Ewert (1978); Vuilleumier (1979); Lentino (1980); IUCN (1982).
Source: Miguel Lentino.
Criteria for inclusion: 2b & 3a.

Laguna de Mucubaji and nearby lakes (26)

Location: 8°47'N, 70°50'W; 40 km northeast of Merida, Merida State.
Area: Laguna de Mucubaji 40 ha; other lakes 22 ha.
Altitude: 3,500-3,700m.
Province and type: 8.34.12; 10, 12 & 19.
Site description: A group of four small permanent freshwater lakes of glacial origin in the paramo zone, with associated peat bogs and fast-flowing mountain streams. The three small lakes are Laguna Negra (12 ha), L. de los Patos (4 ha) and L. La Canao (6 ha).
Principal vegetation: Paramo vegetation characterized by *Espeletia* spp, grasses and small clumps of *Polylepis sericeax*, and with *Hypericum* spp, *Aciachne pulvinata*, and species of *Senecio*, *Jamesonia*, *Arenaria*, *Lupinus*, *Alchemilla*, *Fuchsia* and *Vaccinium*.
Land tenure: State owned.
Protection: In the Sierra Nevada National Park (190,000 ha) established in 1952.
Land use: Tourism and sport fishing.
Waterfowl: Resident breeding species include *Anas flavirostris*, *Merganetta armata* and *Gallinago stricklandii jamesoni*. A variety of species have been recorded as visitors, including *Phalacrocorax olivaceus*, *Anas discors*, *Tringa solitaria* and *Actitis macularia*.
Other fauna: The Park has a rich mammalian fauna including the Spectacled Bear *Tremarctos ornatus*.
Threats: There is a considerable amount of tourist pressure in the Park, and reafforestation with species of *Pinus* is changing the landscape.
Research and conservation: One of the few lacustrine systems in the high Andes of Venezuela; well studied and documented.
References: Ewel et al (1976); Parrish (1976); Vuilleumier & Ewert (1978); Vuilleumier (1979); IUCN (1982).
Source: Miguel Lentino.
Criteria for inclusion: 2b & 3a.

Camatagua Dam (27)

Location: 10°50'N, 67°00'W; near Camatagua, Aragua State.
Area: 7,600 ha.
Altitude: 300m.
Province and type: 8.17.4; 09 & 15.
Site description: A permanent freshwater reservoir, upto 60m deep, fed by slow-flowing rivers; in the high llanos. At low water levels, muddy islands are exposed.
Principal vegetation: In a region of dry tropical forest.
Land tenure: A mixture of state and private ownership.
Protection: Within the Special Protection Zone of the Rio Guarico Basin (40,200 ha) established in 1975.
Land use: Sport hunting and fishing; public recreation; ranching in surrounding areas.
Waterfowl: An important breeding area, particularly for species of Ardeidae. Breeding species include *Phalacrocorax olivaceus, Nyctanassa violacea, Pilherodius pileatus, Cochlearius cochlearius, Bubulcus ibis, Butorides striatus, Egretta alba, Aramides cajanea, Eurypyga helias* and *Jacana jacana. Oxyura dominica* is a regular visitor, and *Anas discors, Tringa solitaria* and *Actitis macularia* are common on migration.
Other fauna: *Caiman crocodilus* and a few *Crocodylus intermedius* occur in the dam.
Threats: There is a considerable amount of disturbance from sport hunting and fishing, and access is unrestricted. Forest fires are a problem in surrounding areas.
Source: Mary Lou Goodwin.
Criteria for inclusion: 2b.

The Llanos (28)

Location: 6°00'-9°00'N, 63°00'-71°00'W; central Venezuela, north of the Orinoco River.
Area: c24,000,000 ha in total, including c.18,000,000 ha of savanna and 6,000,000 ha of semideciduous forest, gallery forest and cultivation; over 10,000,000 ha of wetlands.
Altitude: 30-200m.
Province and type: 8.27.10; 09, 11, 12, 13, 15, 16, 17 & 18.
Site description: The llanos of Venezuela are bounded to the south by the Guyana Shield, to the west by the northern Andes, to the north by the coastal cordillera, and to the east by the Orinoco Delta. Ramo & Busto recognize four distinct zones: (1) the relatively hilly eastern llanos of Anzoategui and Monagas (4,000,000 ha); (2) the rolling central llanos of Guarico and Cojedes (7,150,000 ha); (3) the alluvial plains of the western llanos in Portuguesa and Barinas (5,100,000 ha); and (4) the southern llanos of Apure (7,450,000 ha) characterized by extensive inundation during the rainy season. The principal wetland areas are in zone 4, and the southern parts of zones 2 and 3. They comprise a complex of slow-flowing rivers and streams; associated permanent oxbow lakes, riverine marshes and swamp forest; permanent and seasonal freshwater lakes, ponds and marshes; and large areas of seasonally inundated grassland and palm savanna. In some areas, extensive systems of dyked impoundments or "modulos" have been constructed to retain water in the dry season. In normal years, flooding occurs from June to November, and vast areas of savanna are inundated to a depth of 0.5-1.5m. By March, most areas are dry. Three important areas in the llanos which have received a considerable amount of attention are described separately below.
Principal vegetation: Seasonally inundated grasslands dominated by *Hymenachne amplexicaulis, Leersia hexandra* and *Paspalum repens*; marshes with *Eleocharis intersticta*; lakes and ponds with *Eichhornia crassipes* and species of *Neptunia* and *Salvinia*; swamps with the palms *Mauritia minor* and *M. flexuosa* ("morichales"); gallery forest along the permanent water courses; and grassland with the Llanos Palm *Copernicia tectorum*.
Land tenure: Much of the llanos are privately owned in large ranches (up to 90,000 ha), but there are many small holdings, and large areas are state owned.
Protection: 569,000 ha of the central llanos in Guarico State are included in the Aguaro-Guariquito National Park, established in 1974. This includes all or parts of various ranches, and in default of government enforced protection, ranching and agricultural activities continue as before. 44,500 ha of the western llanos in Portuguesa State are included in the Estero de Chiriguare Wildlife Refuge, established in 1974 (see 28a). The remainder of the

llanos has no legal protection. However, some land owners have taken a considerable interest in practical conservation, and manage their properties with full regard for the conservation of nature.

Land use: The principal activity throughout the region is cattle ranching on large estancias. There is a considerable amount of subsistence agriculture, particularly the cultivation of rice, in some areas; and commercial fishing, sport fishing, game cropping (particularly Capybara), and sport hunting are important locally. On one ranch of 78,000 ha near Mantecal in Apure, a population of 44,000 Capybara supports an annual harvest of about 8,000 animals.

Waterfowl: The wetland areas of the Venezuelan llanos possess an extremely rich and diverse waterfowl community which has been very well documented. Over 70 species occur; most are residents, and many occur in huge numbers. The main breeding species are *Anhinga anhinga, Tigrisoma lineatum, Nycticorax nycticorax, Pilherodius pileatus, Syrigma sibilatrix, Cochlearius cochlearius, Egretta caerulea, E. thula, E. alba, Ardea cocoi*, all three Ciconiidae, *Theristicus caudatus, Cercibis oxycerca, Mesembrinibis cayennensis, Phimosus infuscatus, Eudocimus ruber, Plegadis falcinellus, Ajaia ajaja, Anhima cornuta*, all three *Dendrocygna, Neochen jubata, Amazonetta brasiliensis, Sarkidiornis melanotos, Cairina moschata, Oxyura dominica, Opisthocomus hoazin, Aramus guarauna, Porphyrula martinica, P. flavirostris, Heliornis fulica, Eurypyga helias, Jacana jacana, Vanellus chilensis, Hoploxypterus cayanus, Burhinus bistriatus, Phaetusa simplex, Sterna superciliaris* and *Rynchops niger. Anas discors* is a fairly common winter visitor, and 16 species of Nearctic shorebirds occur on passage or in winter.

In an extensive aerial survey in July 1983, C. Ramo and B. Busto located 100 breeding colonies of Ardeidae and Threskiornithidae in the llanos; 45 of these colonies held over 3,000 pairs of birds, and the largest held over 32,000 pairs. Almost 65,000 pairs of *Eudocimus ruber* were located, in 22 colonies. *Egretta alba* were nesting in 62 colonies, *Bubulcus ibis/Egretta thula* in 60, *Ardea cocoi* in 39, *Anhinga anhinga* in 23, *Euxenura maguari* in 15, and *Phalacrocorax olivaceus* in 8. Over 5,500 *Mycteria americana*, 185 *Jabiru mycteria* and 208 *Ajaia ajaja* were observed during the survey.

Other fauna: The mammalian fauna is very rich and there are particularly high densities of Capybara *Hydrochoerus hydrochaeris* and the deer *Odocoileus virginianus.* The Spectacled Caiman *Caiman crocodilus* is abundant (e.g. an estimated 15,000 on one ranch of 78,000 ha near Mantecal, Apure), and the Orinoco Crocodile *Crocodylus intermedius* and turtle *Podocnemis expansa* occur in small numbers. Fishes include *Cichla ocellaris, Colossoma macropomus, Electrophorus electricus* and *Hemisorubium platyrhynchus.*

Threats: Human population increase continues to put more and more pressure on this marginal habitat which is only really suitable for low density cattle ranching. The principal threat in many areas at the present time is uncontrolled hunting both for food and for the animal trade.

Research and conservation: There is an urgent need for the Government to take the necessary steps to control the irrational exploitation of wildlife, and to establish additional protected areas. Two areas particularly worthy of special protection are the Arismendi area in Barinas State, and the Elorza area in Apure State. More private land owners should be encouraged to adopt a conservation oriented approach to the management of their estancias; and the potential values of rational game cropping and organized nature tourism should be investigated further.

References: Ramia (1967); Bruzual (1976); Ramia & Morales (1978); Casler et al (1979 & 1981); Gomez Dallmeier (1979); Pinowski & Morales (1979 & 1981); Thomas (1979); Pinowski et al (1980); Seijas & Ramos (1980); Morales et al (1981); Zoppi & Michelangelli (1981); Gomez Dallmeier & Rylander (1982); IUCN (1982); Morales (1982 & in press); Morales & Leon (1982); Ramo & Busto (1982a & in press); Bruzual & Bruzual (1983); de Visscher (1983); Madriz (1983); Ramo & Ayarzaguena (1983); Aguilera Prieto (in press); Breymeyer et al (in press); Kushlan et al (in press).

Source: Luis Gonzalo Morales, Betsy Trent Thomas and Andres Eloy Seijas.

Criteria for inclusion: 123.

Estero de Chiriguare Wildlife Refuge and surrounding areas (28a)

Location: 8°35'N, 68°45'W; in the western llanos, 120 km southeast of Guanare, Portuguesa State.

Area: 50,000 ha.

Altitude: 50-55m.

Province and type: 8.27.10; 09, 11, 13 & 16.
Site description: A complex of slow-flowing rivers and streams; riverine marshes; permanent and seasonal freshwater lakes, ponds and marshes; and large areas of seasonally inundated savannas, flooding to a maximum depth of 2m during the rainy season (May to November).
Principal vegetation: Freshwater marshes, savanna with scattered *Copernicia* palms, gallery forest and secondary scrub.
Land tenure: The Wildlife Refuge is state owned; other areas are privately owned.
Protection: 44,500 ha included within the Estero de Chiriguare Wildlife Refuge, established in 1974. The remainder is unprotected.
Land use: Commercial and sport fishing, principally on the Rio Guanare; cattle ranching; subsistence agriculture, particularly the cultivation of rice, using a combination of traditional and modern methods.
Waterfowl: A very rich area for waterfowl characteristic of the llanos. Over 40 species have been recorded, the great majority residents. These include *Anhinga anhinga, Tigrisoma lineatum, Pilherodius pileatus, Syrigma sibilatrix, Mycteria americana, Jabiru mycteria, Cercibis oxycerca, Mesembrinibis cayennensis, Eudocimus ruber, Ajaia ajaja, Anhima cornuta, Dendrocygna bicolor, D. autumnalis, Neochen jubata, Amazonetta brasiliensis, Cairina moschata, Oxyura dominica, Opisthocomus hoazin, Aramus guarauna, Porphyrula martinica, Eurypyga helias* and *Jacana jacana.*
Other fauna: Mammals include *Hydrochoerus hydrochaeris* and *Leo onca*; reptiles include *Caiman crocodilus* and *Eunectes murinus*; and fishes included the commercially harvested *Colossoma macropomus.*
Threats: The extent of ranching and agriculture in the Wildlife Refuge has not diminished since its creation. The felling of timber both for fuel and for construction, and uncontrolled fishing are the principal threats at present.
References: Ramia (1967); Paz et al (1975); IUCN (1982).
Source: See references.
Criteria for inclusion: 2b & 3a.

Esteros de Mantecal (28b)

Location: 7°35'N, 69°10'W; near Mantecal, Apure State.
Area: Unknown.
Altitude: 75-78m.
Province and type: 8.27.10; 09, 11, 12, 13, 15 & 16.
Site description: An area of shallow freshwater lakes, ponds and marshes, and surrounding seasonally inundated savanna in the heart of the southern llanos. An extensive system of impoundments (modulos) has been developed to conserve water supplies and prolong the period of inundation to improve grass production for beef cattle. The impoundents range in size from under 1 ha to 50 ha; they reach a maximum depth of 2m when fully flooded, and retain water for ten months of the year.
Principal vegetation: See site 28; *Leersia* sp grows along the embankments of the modulos,and species of *Hymenachne, Eleocharis* and *Luziola* in the ponds.
Land tenure: Mainly privately owned. Some areas are owned by the local municipality, and a Modulo Experimental Area near Mantecal is state owned.
Protection: No legal protection; but wildlife is protected on some ranches on the private initiative of the land owners, e.g. at Hato El Frio (78,000 ha) east of Mantecal.
Land use: The principal and almost the only economic activity in the region is cattle ranching, but some land owners are successfully "farming" and cropping Capybaras *Hydrochoerus hydrochaeris.*
Waterfowl: A particularly rich part of the llanos for waterfowl, with the full range of species listed under site 28. During a brief visit to El Frio Ranch in January 1984, 56 species of waterfowl were observed, including *65 Tigrisoma lineatum, 150 Nycticorax nycticorax, 25 Cochlearius cochlearius, 950 Bubulcus ibis, 290 Egretta thula, 530 Egretta alba, 90 Mycteria americana, 45 Euxenura maguari, 10 Jabiru mycteria, 30 Theristicus caudatus, 370 Phimosus infuscatus, 355 Eudocimus ruber, 145 Plegadis falcinellus, 135 Ajaia ajaja*, several

thousand *Dendrocygna viduata*, *10,000-20,000* moulting *Dendrocygna autumnalis*, *20 Neochen jubata*, *280 Amazonetta brasiliensis*, *60 Sarkidiornis melanotos*, *26 Cairina moschata*, *30 Oxyura dominica*, 5 Eurypyga helias, over *2,000 Jacana jacana*, *440 Vanellus chilensis*, *185 Himantopus himantopus*, *65 Phaetusa simplex* and eight species of Nearctic shorebirds. There are few areas in South America where such an abundance and diversity of waterfowl can be seen so easily.

Other fauna: Birds of prey are conspicuous; *Cathartes burrovianus*, *Rostrhamus sociabilis*, *Circus buffoni*, *Buteogallus urubitinga* and *Busarellus nigricollis* are common residents in the marshes, and *Pandion haliaetus* is a common winter visitor (e.g. 17 at El Frio ranch in January 1984). Common mammals include Capybara *Hydrochoerus hydrochaeris*, White-tailed Deer *Odocoileus virginianus* and Crab-eating Fox *Cerdocyon thous*; reptiles include *Caiman crocodilus* (abundant), *Podocnemis vogli* and *Eunectes murinus*; and fishes include species of *Serrasalmus*, *Hoplias*, *Hoplerythrinus*, *Hoplosternum*, *Astronotus* and *Eigenmannia*.

Threats: Excessive hunting is a problem in many areas, but the principal threat is the general spread of human population and gradual transformation of the environment.

Research and conservation: The area is of particular interest because of the considerable amount of base-line research which has already been completed, particularly by the Institute of Tropical Zoology at the Central University of Venezuela. Studies currently underway include an assessment of the impact of the modulo system on the avifauna, an evaluation of the effects of hunting during the dry season, and a study of breeding colonies and roosts of Ardeidae, Ciconiidae and Threskiornithidae.

References: Ramia (1974); Gomez (1976); Bulla & Miranda et al (1980); Bulla & Pacheco et al (1980); Pinowski et al (1980); Ramos et al (1981); Hernandez et al (1981); Morales et al (1981); Kushlan et al (1982 & in press).

Source: James A. Kushlan, Luis Gonzalo Morales and Derek A. Scott.

Criteria for inclusion: 123.

Masaguaral Ranch (28c)

Location: 8°31'N, 67°35'W; 45 km SSE of Calabozo, Guarico and Apure States.

Area: 3,400 ha.

Altitude: 63m.

Province and type: 8.27.10; 09, 11, 12, 13 & 16.

Site description: A typical ranch of the central llanos, with less extensive flooding and fewer permanent water bodies than areas further to the south in Apure State. The two small rivers (Rio Guarico and Caño Caracol) which flow through the ranch are reduced to a series of small pools by the end of the dry season. 76% of the area is grassland with scattered palms and small clumps of trees; the remainder is gallery forest. A number of small lakes and marshes are kept flooded through the dry season by pumping. Extensive flooding occurs during the rainy season (May to October).

Principal vegetation: Grassland with the palm *Copernicia tectorum*; dry tropical woodland;and gallery forest.

Land tenure: A privately owned ranch.

Protection: No legal protection, but maintained as a private faunal and floral reserve since the early 1950s.

Land use: Cattle ranching, at low density.

Waterfowl: The ranch has a very diverse avifauna including most typical llanos species (54 species of waterfowl recorded). Of particular interest are the breeding colonies of Ardeidae, and large concentrations of Anatidae. Peak counts have included 400 *Dendrocygna bicolor*, 15,000 *Dendrocygna viduata*, 10,000 *Dendrocygna autumnalis*, 250 *Sarkidiornis melanotos* and *50 Cairina moschata*. Up to 29 pairs of *Euxenura maguari*, 6 pairs of *Jabiru mycteria* and several pairs of *Anhima cornuta* nest on the ranch, and *Aramides cajanea*, *Eurypyga helias* and *Burhinus bistriatus* are common. Small numbers of *Anas discors* occur in winter.

Other fauna: Over 250 species of birds have been recorded on the ranch. Common mammals include *Hydrochoerus hydrochaeris*, *Cerdocyon thous* and *Odocoileus virginianus*; and *Caiman crocodilus* is abundant.

Threats: None.

Research and conservation: A small research facility has been provided by the owners, and a number of faunal and floral investigations have been completed or are in progress. The avifauna has been particularly well documented (Thomas, 1979); and the ranch has become a popular port of call for wildlife tours.
References: Thomas (1979).
Source: Betsy Trent Thomas and Derek A. Scott.
Criteria for inclusion: 3a.

Guri Dam (29)

Location: 7°30'N, 62°50'W; 90 km southeast of Ciudad Bolivar, Bolivar State.
Area: 400,000 ha when fully flooded.
Altitude: 180m.
Province and type: 8.27.10; 15.
Site description: A large reservoir recently constructed on the Rio Caroni, below its confluence with the Rio Paragua.
Principal vegetation: No information.
Land tenure: State owned.
Protection: None at present.
Land use: Generation of hydroelectricity.
Waterfowl: No information.
Other fauna: No information.
Threats: No information.
Research and conservation: A large wetland reserve is being established at the dam. It will be interesting to study the development of the wetland fauna at this enormous dam in an area devoid of large natural wetlands.
Source: Andres Eloy Seijas.
Criteria for inclusion: 0.

Rio Caura (30)

Location: 6°00'N, 64°15'W to 7°40'N, 65°00'W; south of the Rio Orinoco, western Bolivar State.
Area: c.250 km of river.
Altitude: 30-350m.
Province and type: 8.27.10; 09 & 11.
Site description: The lower 250 km of the Rio Caura from the region of Salto las Pavas to its confluence with the Rio Orinoco; a slow-flowing river with sand banks, riverine marshes and riverine forest.
Principal vegetation: No information.
Land tenure: No information.
Protection: None.
Land use: No information.
Waterfowl: No information.
Other fauna: A significant population of the endangered Orinoco Crocodile *Crocodylus intermedius* was located by an expedition from Guanare University and Florida State Museum in 1981. During a study in 1982, over 70 sightings were made, and three nesting beaches located. This may constitute the last viable population of *C. intermedius* in the wild anywhere.
Threats: Plans exist to build a hydroelectric dam on the river near Salto las Pavas; and increasing human settlement in the area could threaten the small and vulnerable crocodile population.
Research and conservation: The University of Guanare and Florida State Museum are conducting studies on the crocodile population with a view to developing a management plan to conserve the species.
References: Anon (1982); Franz et al (1982).
Source: See references.
Criteria for inclusion: 2a.

COUNTRY REPORTS

Central America

BELIZE

INTRODUCTION

by **Dora Weyer**

Belize is a small Central American nation bordered on the north and northwest by Mexico, and on the west and south by Guatemala. Formerly a British dependency, it achieved full independence in 1981. With an area of some 23,000 km^2 and a population of only about 150,000, the population density is the lowest in Central America.

The climate is tropical with a poorly defined rainy season from mid May to mid January. The coastlands are low and swampy with extensive mangrove swamps and both fresh and saline lagoons. In the north the land is low and flat, with large tracts of pine savanna and hardwood forest, but in the west and southwest there is a heavily forested mountain massif rising to over 1,000 m. The coastal waters are generally shallow, and there is an almost continuous line of reefs and cays 22 to 90 kms offshore, stretching the full length of the country. This is the largest barrier reef in the Northern Hemisphere.

Much of the country remains virtually undisturbed by man. There has been very little agricultural activity until recently, and the selective logging methods employed in the past were not, on the whole, too destructive. The Maya Mountains in the south are extremely rugged and large parts remain inaccessible. Unfortunately, in the last few years the influx of refugees from El Salvador, Guatemala and Honduras has severely increased the rate of destruction of habitat and the illegal killing of wildlife.

Institutional Base for Wetland Conservation and Research

The Government agency involved with the conservation of wetlands and their wildlife in Belize is the Department of Forestry, with headquarters in Belmopan. The only non-governmental institution involved is the Belize Audubon Society.

Progress in Wetland Conservation and Research

Interest in the conservation of wildlife is just beginning, due primarily to the work of the Belize Audubon Society. However, Government officials are now becoming cognizant of the need for conservation of natural resources, and the upper classes of society are more and more evincing an interest in the country's fantastic wealth of game and non-game species.

Government passed two laws in November 1981 of importance to wildlife and wildlands conservation. The first law laid the legal groundwork for the establishment of national parks and wildlife refuges. Half Moon Cay Reserve was the first result of that legislation, and Crooked Tree Wildlife Reserve followed in December 1984. This last includes eight lagoons, the incoming creeks, and some 16-24 kms of Black Creek, a forested creek draining six of the lagoons, and emptying into the Belize River. The Crooked Tree area is critical to waterfowl during the dry season. Its status as a protected refuge for these birds (and reptiles and mammals) is being made possible by funding from the Wildwings Foundation of New York City.

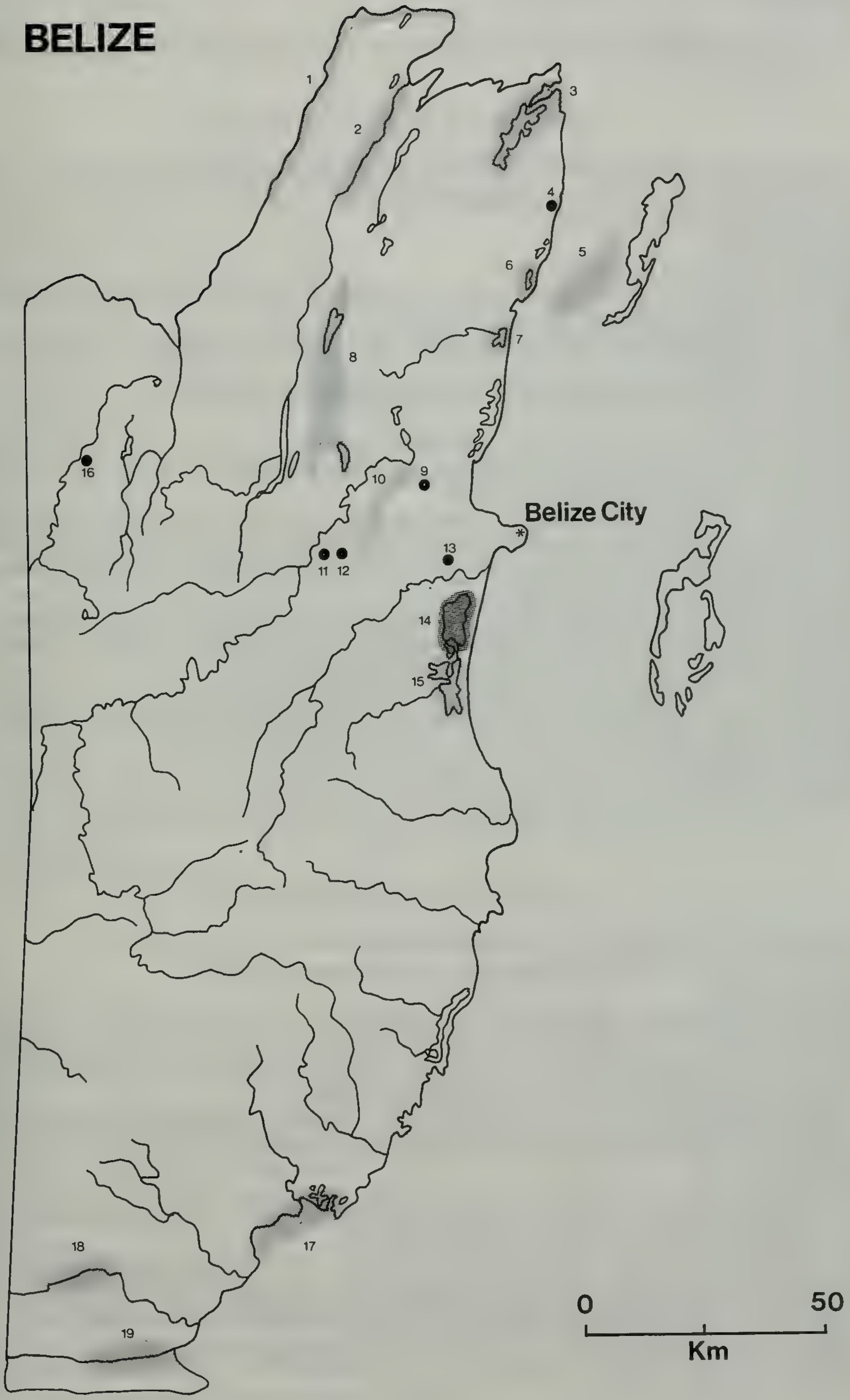
The second legislation passed in November 1981 was a revision of the game laws. These new laws forbid the taking of all waterbirds with the exception of migrant ducks.

Like many other countries in the region, Belize is suffering severe economic restraints. Despite the best efforts of Government, it has been impossible to finance the game wardens and administrative personnel necessary for running a wildlife refuge or enforcing the game laws. Therefore all monies for such undertakings must come from outside help.

The Belize Audubon Society has been trying, through a weekly five minute radio programme and through the schools and public communications, to build up a social and cultural change of thought as regards wildlife of all kinds. To date, this programme has been only partially effective, and has particularly failed with the rural population which does most of the illegal hunting, many rural families depending on wild game for their protein. Much of the reason for this failure has been lack of money for printing and for transportation to get out to the schools. Recently, the Government education department has been able to cooperate more fully in getting materials published and out to the rural schools. WWF Norway is donating funds for rural wildlife education, and RARE, now under the aegis of WWF-US, is donating posters and financing a continuing workshop course for one of Belize's leading teachers and for an employee of the Fisheries Department.

Very little research has been conducted on the wildlife of Belize, particularly in areas away from the central and most densely populated part of the country. The author and colleagues have conducted a number of avifaunal surveys of wetlands throughout the country since the late 1960s, and in recent years aerial surveys have been conducted by the Belize Audubon Society, with the support of the W.W. Brehm Fund in the Federal Republic of Germany. The aerial surveys have concentrated on the status of the Jabiru *Jabiru mycteria*, an endangered species in Central America. Other recent research relevant to wetlands has included a study of the status of Morelet's Crocodile *Crocodylus moreletii* by Abercrombie *et al* (1980).

The IUCN is assisting the Government of Belize in the development of a national conservation strategy (Hunkeler, 1983), and the U.S. Agency for International Development funded a Country Environmental Profile which was published in 1984.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WETLANDS

Site descriptions based on data sheets provided by Dora Weyer of the Belize Audubon Society

Marshes along the lower Rio Hondo (1)

Location: 18°05'-18°30'N, 88°22'-88°45'W; along the Mexico/Belize border from Yo Creek to the river mouth, Orange Walk and Corozal Districts.
Area: Unknown; c.60 km of river.
Altitude: 0-10m.
Province and type: 8.1.1; 09, 11 & 18.
Site description: A slow-flowing river in the lowlands, bordered by extensive swamp forests subject to inundation during the rainy season.
Principal vegetation: Swamps with forested hammocks, and swamp forest; in a region of semi-humid forest.
Land tenure: Various; the State owns all areas below high water mark.
Protection: None.
Land use: Primitive agriculture and subsistence hunting. There are several villages on higher ground in both countries, and two villages on Albion Island at the edge of the swamp. The region was formerly occupied by Mayans.
Waterfowl: Poorly known; *Aramus guarauna* is common, and *Dendrocygna autumnalis* and *Cairina moschata* are reported to occur. During an aerial survey in April 1984, a pair of *Jabiru mycteria* was found nesting just south of San Antonio on Albion Island, but no colonies of Ardeidae were located.
Other fauna: The area is reportedly still very rich in wildlife. *Leo onca* and *Tapirus bairdii* occur, and crocodilians, probably both *Crocodylus acutus* and *C. moreletii*, are common. The Central American Otter *Lutra anectens* presumably occurs.
Threats: The only threat at present seems to be excessive hunting.
Research and conservation: A poorly known area which is difficult of access and remains relatively undisturbed.
Source: Dora Weyer.
Criteria for inclusion: 0.

Marshes along the lower New River (2)

Location: 18°15'-18°22'N, 88°25'W; SSW of Corozal town, Corozal District.
Area: Unknown; c.35 km of river.
Altitude: 1-2m.
Province and type: 8.1.1; 08, 09, 11, 13, 16 & 18.
Site description: An extensive and almost impenetrable complex of forested swamps, freshwater marshes, mangrove swamps and seasonally flooded plains along the lower New River; flooding to a depth of 3-4m during the rainy season.
Principal vegetation: Semi-humid forest, mangrove swamps and high grass and *Scirpus* marshes.
Land tenure: Mostly state owned (up to the high water mark), with some private holdings in drier areas.
Protection: None.
Land use: Cultivation of sugar cane in cleared areas. There is one sugar mill in the immediate area at Libertad, and another up river at Tower Hill.
Waterfowl: Poorly known; species likely to be present in significant numbers include *Tigrisoma mexicanum, Cochlearius cochlearius, Dendrocygna autumnalis, Cairina moschata, Rallus longisrostris, Aramides axillaris, A. cajanea, Porzana flaviventer* and *Laterallus ruber.*
Other fauna: No information.
Threats: The main threat is pollution from the sugar mills, which discharge oil and bagasse effluent into the river.

Research and conservation: The area is inaccessible by road, and has never been properly surveyed.
Source: Dora Weyer.
Criteria for inclusion: 0.

Shipstern Lagoon and Shipstern Cay (3)

Location: 18°18'N, 88°07'-88°10'W; in northeastern Corozal District.
Area: Lagoon 4,200 ha; Cay 1 ha.
Altitude: 0-3m.
Province and type: 8.1.1; 01, 03, 07, 08 & 12.
Site description: A large shallow fresh to brackish coastal lagoon, up to 3m deep, with fringing marshes and mangrove swamps, subject to tidal influence and flooding during the rainy season. The lagoon is almost fresh at its inland end, and brackish near the coast. Shipstern Cay is a small offshore island with mangrove swamps in the adjacent shallow sea bay.
Principal vegetation: Mangrove swamps dominated by *Rhizophora mangle*, and grassy marshes.
Land tenure: State owned.
Protection: None.
Land use: Fishing; fishermen occasionally collect eggs and young birds from the breeding colony on Shipstern Cay.
Waterfowl: Shipstern Lagoon was formerly the site of a large colony of *Egretta alba* and *Mycteria americana*, but this was abandoned in 1982. In 1984, there were about 54 pairs of *E.alba* and 12 pairs of *Phalacrocorax olivaceus* nesting on two small cays in the lagoon. *Rallus longirostris* occurs in the mangroves. Shipstern Cay still holds 200 pairs of *Eudocimus albus* (the second largest colony in Belize), 12 pairs of *Egretta rufescens* (two-thirds of the Belize population), and 10 pairs of *E. tricolor*.
Other fauna: About 50 pairs of White-winged Doves *Zenaida asiatica* were nesting at Shipstern Lagoon in 1982. This species is rare elsewhere in Belize.
Threats: Persecution of the breeding colony of egrets and storks at Shipstern Lagoon resulted in its abandonment in 1982; there is some persecution at the colony at Shipstern Cay, eggs and young birds being taken for sale in Chetumal in Mexico. There is some pollution from the pulp plant in Chetumal, and this is likely to pose an increasing threat to inshore waters.
Research and conservation: Several avifaunal surveys have been conducted by Dora Weyer.
Source: Dora Weyer.
Criteria for inclusion: 2b, 2c & 3a.

Lagoons and marshes near High Bluff (4)

Location: 18°06'N, 88°07'W; inland from High Bluff on the coast south of Shipstern Lagoon, Corozal District.
Area: c.2,500 ha.
Altitude: 0m.
Province and type: 8.1.1; 07 & 08.
Site description: A permanent brackish coastal lagoon and extensive marshes, with several mangrove cays; subject to tidal fluctuations.
Principal vegetation: Mangrove swamps and grassy marshes.
Land tenure: State owned.
Protection: None.
Land use: Fishing and hunting.
Waterfowl: An important breeding area for Ciconiiformes; up to 100 pairs of *Egretta alba*,300 pairs of *Mycteria americana* and 2 pairs of *Ajaia ajaja* (the only breeding birds in Belize) have nested, along with small numbers of *Phalacrocorax olivaceus*.
Other fauna: No information.
Threats: The only threat seems to be excessive hunting.

Research and conservation: Aerial surveys of breeding birds were conducted by Dora Weyer and Ford Young between 1972 and 1977, and again in 1984. The breeding populations of waterfowl have decreased in recent years as a result of persecution. It is essential that this formerly important breeding site be protected while some birds continue to use it.
Source: Dora Weyer.
Criteria for inclusion: 2b, 2c & 3a.

Cays west of Ambergris Cay (5)

Location: 17°57'N, 88°06'W to 18°04'N, 87°57'W; five small cays west of Ambergris Cay in the northern Barrier Reef.
Area: Under 4 ha.
Altitude: 0m.
Province and type: 8.1.1; 01, 03 & 08.
Site description: Five mangrove covered cays in a shallow sea bay (Bahia Chetumal) within the coastal barrier reef. The cays are as follows: Cayos Pajaros (two small cays, each less than 100m across); Cayo Rosario; Mosquito Cay; and Savannah Cay.
Principal vegetation: Mangrove swamps with *Rhizophora mangle.*
Land tenure: State owned.
Protection: None.
Land use: None, other than the occasional raiding of birds' nests by fishermen.
Waterfowl: An important breeding area for Ciconiiformes, with some cormorants and pelicans. Breeding species include *Pelecanus occidentalis* (7 nests on Cayos Pajaros in 1984), *Phalacrocorax olivaceus, Egretta caerulea, E. tricolor, E. rufescens* (4-5 nests on Cayos Pajaros in 1984), *Eudocimus albus* (large colonies on Cayos Pajaros and Cayo Rosario in 1969, but no birds nesting in 1984), and *Ajaia ajaja* (a large colony on Cayo Rosario in 1969, but no birds in 1984). *Phalacrocorax auritus* probably nests on Mosquito Cay, and *Cochlearius cochlearius* probably nests near Savannah Cay.
Other fauna: The Osprey *Pandion haliaetus* nests on Cayo Rosario, and the bay supports a very rich marine fauna.
Threats: The breeding colonies of waterfowl are much persecuted by fishermen for food, and the populations are now greatly reduced in size.
Research and conservation: Aerial and boat surveys were conducted by Dora Weyer and Ford Young between 1969 and 1975, and again in 1984. Unless the cays are given some protection in the near future, their breeding birds will disappear.
Source: Dora Weyer.
Criteria for inclusion: 2b, 2c & 3a.

Bennett's Lagoon (6)

Location: 17°58'N, 88°10'W; on the coast 50 km north of Belize City, Corozal District.
Area: 400 ha.
Altitude: 0m.
Province and type: 8.1.1; 07 & 08.
Site description: A brackish coastal lagoon with several mangrove covered cays, and surrounding mangrove swamps and brackish marshes; subject to tidal influence.
Principal vegetation: Mangrove swamps and grassy marshes.
Land tenure: State owned.
Protection: None.
Land use: Some hunting, but otherwise little disturbed.
Waterfowl: Birds observed during surveys in February and April 1984 included 50 breeding pairs of *Egretta alba*, 200 breeding pairs of *Mycteria americana*, a number of *Rallus longirostris* and a few *Aramus guarauna.*
Other fauna: No information.
Threats: There is some persecution of the breeding birds.

Research and conservation: Several aerial surveys have been conducted by Dora Weyer, Ford Young and Martin Meadows.
Source: Dora Weyer.
Criteria for inclusion: 2c.

Northern River Lagoon (7)

Location: 17°52'N, 88°13'W; on the coast 40 km north of Belize City, Belize District.
Area: 800 ha.
Altitude: 0m.
Province and type: 8.1.1; 07 & 08.
Site description: A large brackish coastal lagoon with surrounding brackish marshes and a few mangrove covered cays; subject to tidal influence.
Principal vegetation: Mangrove swamps and grassy marshes.
Land tenure: State owned.
Protection: None.
Land use: Some fishing, but otherwise very little disturbed.
Waterfowl: Birds observed during aerial surveys in February and April 1984 included 140 breeding pairs of *Phalacrocorax olivaceus*, 80 breeding pairs of *Egretta alba*, and 200 wintering *Fulica americana.*
Other fauna: No information.
Threats: Some disturbance from fishermen.
Research and conservation: Aerial surveys were conducted by Dora Weyer, Ford Young and Martin Meadows in 1984.
Source: Dora Weyer.
Criteria for inclusion: 2c & 3a.

Crooked Tree Lagoon (8)

Location: 17°45'N, 88°32'W; 45 km northwest of Belize City, Orange Walk and Belize Districts.
Area: 8,000-10,000 ha, possibly more.
Altitude: 15m.
Province and type: 8.1.1; 09, 11, 12 & 18.
Site description: A complex of permanent and seasonal, shallow freshwater lakes and marshes, some very shallow, drying out in the dry season (March to May), and others up to 3m deep, retaining water throughout most dry seasons. Several creeks drain into and out of the lakes, and extensive areas of the surrounding swamp forests flood during the rainy season. The area includes Calabash Pond, Revenge Lagoon, Crooked Tree Lagoon, Western Lagoon, Poorhaul Creek Lagoon, Spanish Creek Lagoon, Southern Lagoon, Mexico Lagoon, Jones Lagoon and almost the entire length of Black Creek to the Belize River.
Principal vegetation: Abundant submergent aquatic vegetation in the lagoons; extensive shrub borders to the lagoons; forests of *Haematoxylum campechianum* (the only large stands remaining in Belize); mixed pine savannas with some hardwoods; and hardwood forest, particularly along Black Creek.
Land tenure: Largely state owned, including all land below high water mark. There are some private holdings, and large areas under disputed ownership.
Protection: The greater part of the basin, including all the lagoons listed in the site description, has been included in the Crooked Tree Wildlife Reserve, established in December 1984.
Land use: The area was the centre of the logwood *Haematoxylum campechianum* industry in the 19th century, but there is now little forestry in the area. There is some cattle ranching near Crooked Tree village, and an important fishery, particularly during the dry season. There is also some hunting and sport fishing by tourists and "weekend" hunters from Belize City.
Waterfowl: An extremely important area for waterfowl, and critical habitat during the dry season, when birds concentrate in very large numbers around the permanent lagoons. Seventy-four species of waterfowl have been recorded. Peak numbers have included many

thousands of *Phalacrocorax olivaceus, 32 Tigrisoma mexicanum, 70 Nycticorax nycticorax, 400 Cochlearius cochlearius, 200 Butorides virescens, 200 Egretta caerulea, 100 E. tricolor, 1,000 E. thula, 2,600 E. alba, 22 Ardea herodias, 1,000 Mycteria americana, 24 Jabiru mycteria* (the entire Belize population), *2,000 Eudocimus albus, 34 Ajaia ajaja, 1,000 Anas discors, 32 Cairina moschata, 2,000 Aramus guarauna, 1,000 Fulica americana, 160 Himantopus himantopus and 125 Hydroprogne caspia.* The rare *Agamia agami* has been recorded along the forested creeks in the reserve.

Breeding species include *Phalacrocorax olivaceus, Anhinga anhinga, Cochlearius cochlearius, Bubulcus ibis, Egretta thula, E. alba, Jabiru mycteria* (one pair), *Aramus guarauna*, a variety of Rallidae, *Heliornis fulica, Jacana spinosa* (abundant), and *Himantopus himantopus.* Twenty-seven species of Nearctic shorebird have been recorded on migration and in winter, including up to *800 Tringa flavipes, 70 T. solitaria*, 70 Limnodromus griseus, 100 Calidris fuscicollis and *250 C. melanotos.*

Other fauna: The area is very rich in wildlife. About 260 species of birds have been recorded, including 99 species of Nearctic migrants. Birds of prey are common; up to 34 Lesser Yellow-headed Vultures *Cathartes burrovianus* have been observed in spring and some may breed. Other breeding species include *Pandion haliaetus, Leptodon cayanensis, Rostrhamus sociabilis, Buteogallus anthracinus, B. urubitinga* and *Busarellus nigricollis.* Mammals include the Central American Otter *Lutra anectens*, and reptiles include *Crocodylus moreletii* and all the species of freshwater turtle known from Belize. The lagoons are famous for their large tarpon *Megalops atlantica.*

Threats: A major highway has recently been constructed within a few kilometres of the lagoon, providing all-weather access to the area and resulting in a great increase in hunting activities and other forms of disturbance. A farm-to-market road is now being constructed through the area.

Research and conservation: Numerous avifaunal surveys were conducted in the area by Dora Weyer and colleagues of the Belize Audubon Society between 1968 and 1984, but access has always been difficult during the dry season when the birds are conecntrated here, and comprehensive counts at that season have been impossible.

Source: Dora Weyer.

Criteria for inclusion: 123.

Burrell Creek Lagoon (9)

Location: 17°35'N, 88°26'W; on Burrell Creek, 26 km WNW of Belize City, Belize District.

Area: 2 ha.

Altitude: 3-4m.

Province and type: 8.1.1; 12 & 18.

Site description: A small freshwater lake and marshes, 2-3m deep, and surrounding swamp forest, subject to seasonal flooding. Burrell Creek drains pasture land upstream.

Principal vegetation: In a region of humid tropical forest.

Land tenure: Land below high water mark is state owned; adjacent dry lands are owned by Tennessee Agriculture Ltd.

Protection: No legal protection, but present and past owners of surrounding land have afforded the lake some protection.

Land use: Occasional hunting and fishing.

Waterfowl: There is a small breeding colony of *Cochlearius cochlearius* (15-20 nests), andthe area is excellent habitat for the rare *Agamia agami.*

Other fauna: *Lutra anectens, Tapirus bairdii* and *Crocodylus moreletii* are known to occur.

Threats: The nearby village of Burrell Boom is expanding towards the lake shore.

Research and conservation: Several avifaunal surveys have been conducted by Dora Weyer since 1969.

Source: Dora Weyer.

Criteria for inclusion: 3a.

Mussel Creek (10)

Location: 17°35'N, 88°28'W; 15 km west of Burrell Boom, Belize District.
Area: Unknown; c.30 km of creek.
Altitude: 4m.
Province and type: 8.1.1; 09, 11 & 18.
Site description: A slow flowing river with associated riverine lakes and marshes, meandering through swamp forest. The river is subject to seasonal flooding, and can reach a depth of 5-6m. It rises in Cox, Mucklehany and Cook's Lagoons, and flows into the Belize River.
Principal vegetation: Riverine marshes, swamp forest with patches of wild cane, and humid tropical forest.
Land tenure: Areas below high water mark and much of the shoreline are state owned; elsewhere there are several small privately owned farms.
Protection: None, but at the request of the Belize Audubon Society, the Government has put up signs prohibiting shooting where the road crosses the creek.
Land use: Fishing, including some fishing with illegal nets; and hunting.
Waterfowl: After Crooked Tree Lagoon (site 8), perhaps the richest area for waterfowl in Belize. There are no large breeding colonies of Ardeidae, but the large colonies of *Phalacrocorax olivaceus* include a scattering of *Egretta alba* along with some *Anhinga anhinga*. Other species known to breed include *Tigrisoma mexicanum*, *Cochlearius cochlearius*, *Bubulcus ibis*, *Butorides virescens*, *Agamia agami*, *Jabiru mycteria*, *Dendrocygna autumnalis*, *Cairina moschata*, *Aramus guarauna*, *Aramides cajanea*, *Laterallus ruber*, *Heliornis fulica*, and *Jacana spinosa*. *Botaurus pinnatus* is of regular occurrence, and probably breeds.
Other fauna: The area is rich in birds of prey and kingfishers Alcedinidae. Large individuals of *Boa constrictor* have been seen, *Crocodylus moreletii* presumably occurs, and large Tarpon *Megalops atlantica* are present. The Central American Otter *Lutra anectens* was observed in December 1984.
Threats: None at present except for some illegal sport hunting, and subsistence hunting by local inhabitants.
Research and conservation: The Belize Audubon Society "Belize City Area" Christmas bird counts include a small part of this complex. Dora Weyer has conducted regular avifaunal surveys since 1969, and has proposed that a wildlife reserve be created in the area.
Source: Dora Weyer.
Criteria for inclusion: 2c & 3a.

Big Falls Rice Ranch (11)

Location: 17°29'N, 88°31'W; on the Belize River 40 km west of Belize City, Belize District.
Area: 1,200 ha.
Altitude: 15m.
Province and type: 8.1.1; 17 & 18.
Site description: A complex of canals and shallow freshwater impoundments, up to 30 cm deep, for rice cultivation, with surrounding swamp forests created by run-off. The water levels are manipulated for rice growing.
Principal vegetation: Rice fields and swamp forest, with high grasses and shrubs on dry ground by the canals; in a region of humid tropical forest.
Land tenure: Formerly owned by the Big Falls Rice Farm, but now held in receivership under Government supervision, and up for sale.
Protection: No habitat protection, but hunting has been prohibited, except for Anatidae, until the area is sold.
Land use: Rice cultivation; there is some shooting of ducks which damage the crops.
Waterfowl: A very important feeding area for a wide variety of waterfowl including many Ardeidae, *Mycteria americana*, *Jabiru mycteria*, *Eudocimus albus*, *Ajaia ajaja*, large numbers of *Dendrocygna autumnalis* and *Cairina moschata*, *Aramus guarauna* and several Rallidae. Many waterfowl breed around the edges of the rice fields and in adjacent swamp forest, including *Tigrisoma mexicanum*, *Jabiru mycteria*, *Aramus guarauna*, *Rallus maculatus*, *Aramides cajanea*, *Porzana flaviventer*, *Laterallus ruber* and *Porphyrula martinica*. Wintering

Nearctic migrants include up to 2,000 *Anas discors*, a few *A. acuta*, and up to 1000 *Porzana carolina.*

Other fauna: The surrounding forests are rich in wildlife, including *Leo onca* and *Tapirus bairdii.*

Threats: None known.

Research and conservation: Dora Weyer and the Belize Audubon Society have conducted a number of avifaunal surveys. The status of the area remains uncertain until the land is sold. However, several duck-hunting clubs have shown an interest in the property.

Source: Dora Weyer.

Criteria for inclusion: 2b.

Cox's Lagoon, Mucklehany Lagoon and Cook's Lagoon (12)

Location: 17°30'N, 88°30'W; at the headwaters of Mussel Creek, 35 km west of Belize City, Belize District.

Area: Several thousand ha.

Altitude: 10m.

Province and type: 8.1.1; 12 & 18.

Site description: Three permanent freshwater lakes with some marshes and swamp forest, subject to seasonal flooding.

Principal vegetation: Marshes with grasses, sedges and palms; and swamp forest. Mucklehany Lagoon is surrounded by humid tropical forest, Cook's Lagoon is surrounded by pine savanna, and Cox's Lagoon has both habitats in surrounding areas.

Land tenure: Partly state owned and partly owned by the Big Falls Rice Farm, with some small private holdings.

Protection: None.

Land use: Occasional hunting and fishing.

Waterfowl: Poorly known; *Jabiru mycteria* has nested to the west of Mucklehany Lagoon, and local inhabitants report large numbers of *Dendrocygna autumnalis* and *Cairina moschata* nesting here.

Other fauna: *Tapirus bairdii* and *Crocodylus moreletii* are abundant, especially near Cox's and Mucklehany Lagoons.

Threats: None at present, but there is a potential threat from development for rice cultivation and cattle ranching.

Research and conservation: Dora Weyer has conducted several avifaunal surveys by boat, and two aerial surveys with Ford Young and Martin Meadows in 1984, but the area remains relatively poorly known.

Source: Dora Weyer.

Criteria for inclusion: 2a & 3a.

Faber's Lagoon and marshes to the north and east (13)

Location: 17°28'N, 88°16'W; 12 km west of Belize City, Belize District.

Area: Several hundred ha.

Altitude: 0m.

Province and type: 8.1.1; 07, 08 & 12.

Site description: A complex of shallow fresh and brackish coastal lagoons, mostly under 2m deep, with adjacent mangrove swamps. Some of the lagoons are subject to tidal influence.

Principal vegetation: Freshwater marshes and mangrove swamps.

Land tenure: State owned.

Protection: None.

Land use: Fishing and some hunting.

Waterfowl: An important feeding area for *Egretta caerulea, E. tricolor, E. thula, E. alba, Eudocimus albus* and *Dendrocygna autumnalis. Podilymbus podiceps, Podiceps dominicus* and *Jacana spinosa* are common on the freshwater lagoons, and *Rallus longirostris* is common in the mangroves and brackish marshes.

Other fauna: The Central American Otter *Lutra anectens* has been reported, and both *Crocodylus acutus* and *C. moreletii* breed here.
Threats: Belize City is encroaching on the area; nearby land has been filled for industry and housing developments, and the lagoons are likely to be used as refuse dumps.
Research and conservation: Dora Weyer has conducted several avifaunal surveys in the area.
Source: Dora Weyer.
Criteria for inclusion: 2a & 3a.

Northern Lagoon (14)

Location: 17°22'N, 88°19'W; 20 km southwest of Belize City, Belize District.
Area: 3,200 ha.
Altitude: 0m.
Province and type: 8.1.1; 07 & 08.
Site description: A permanent brackish coastal lagoon and associated fresh to brackish marshes, with mangrove swamps and a mangrove covered cay (Bird Cay); subject to tidal influence. During high tides there is slow drainage through the marshes directly to the sea, but at other times most water drains out through the Southern Lagoon (site 15).
Principal vegetation: Mangrove swamps and sedge and grass marshes; a few coconut palms on Bird Cay, and pine savanna to the west.
Land tenure: State owned, but Bird Cay is under the care of the Belize Audubon Society.
Protection: Supposedly under the protection of the Belize Audubon Society, but funds are lacking to support a warden.
Land use: Duck hunting and fishing; the lagoon forms part of the inland boat passage from Gales Point, but this is no longer heavily used (only 3 to 5 small boats a day).
Waterfowl: One of the most important breeding areas for waterfowl in Belize; the main colony is on Bird Cay, with some overspill onto other small cays and mangroves along the shore. Breeding birds include 20-25 pairs of *Phalacrocorax olivaceus*, 12-15 pairs of *Anhinga anhinga*, 20-30 pairs of *Egretta thula*, 400-600 pairs of *E. alba* (the second largest colony in Belize), and 400-500 pairs of *Eudocimus albus* (the largest colony in Belize). *Nycticorax nycticorax*, *Cochlearius cochlearius*, *Egretta caerulea* and *E. tricolor* nest in smaller numbers. One pair of *Jabiru mycteria* has nested near the lagoon for many years. The lagoon often holds 1,000-2,000 *Aythya affinis* in autumn, but the birds move to a feeding area just east of St. George's Cay for much of the winter.
Other fauna: Manatees *Trichechus manatus* are occasional visitors.
Threats: None at present except for uncontrolled hunting and occasional vandalism by "tourists" at the breeding colonies.
Research and conservation: Regular avifaunal surveys have been conducted by Dora Weyer and the Belize Audubon Society since 1971. The lagoon is under no immediate threat, and with better wardening could be maintained as one of the most important breeding areas for herons and ibises in Belize.
Source: Dora Weyer.
Criteria for inclusion: 2c & 3a.

Southern (Manatee) Lagoon (15)

Location: 17°15'N, 88°20'W; 30 km SSW of Belize City, Belize District.
Area: 3,200 ha.
Altitude: 0m.
Province and type: 8.1.1; 07 & 08.
Site description: A deep brackish coastal lagoon and extensive mangrove swamps bordered in the east by a sedge and grass marsh; at the mouth of the Manatee River. The lagoon is subject to tidal influence and has a direct outlet to the sea through an extension of the Manatee River. Submergent vegetation is fairly abundant at the northern end, where the canal from the Northern Lagoon (site 14) enters. The area between the Northern and Southern Lagoons is all mangrove swamps.

Principal vegetation: Mangrove swamps, and sedge and grass marshes; pine savanna to the west.
Land tenure: Mostly state owned, with some private holdings.
Protection: None.
Land use: Mainly subsistence fishing, with some hunting and tourist recreation. The village of Gales Point lies at the south end of the lagoon. In the late 1960s and early 1970s, there was a logging and plantation operation to the south, but this has now been abandoned. Parts of the area are still relatively undisturbed.
Waterfowl: There are no large breeding colonies of Ciconiiformes, but the lagoon is an important feeding area for many species. Resident species which are known or thought to breed include *Tigrisoma mexicanum, Butorides virescens, Aramus guarauna, Rallus longirostris, Aramides axillaris* and *A. cajanea.*
Other fauna: The manatee *Trichechus manatus* is common, particularly in the lower Manatee River; the otter *Lutra anectens* and crocodilians *Crocodylus acutus* and *C. moreletii* undoubtedly occur.
Threats: None at present, except for some hunting pressure.
Research and conservation: Several avifaunal surveys have been conducted by Dora Weyer and the Belize Audubon Society since 1968. There is currently a proposal to create a Manatee Reserve which would include the southern portion of the lagoon (around the village of Gales Point), and the lower part of the Manatee River.
Source: Dora Weyer.
Criteria for inclusion: 2a & 3a.

Laguna Seca (16)

Location: 17°38'N, 89°03'W; southeast of the Rio Bravo Escarpment, 10 km north of Gallon Jug, Orange Walk District.
Area: 300 ha.
Altitude: 120m.
Province and type: 8.1.1; 12.
Site description: A shallow freshwater lake with extensive sedge and grass marshes, subject to flooding during the rainy season.
Principal vegetation: Sedge and grass marshes.
Land tenure: Owned by Belize Estates Ltd., a logging company.
Protection: None.
Land use: A very remote and undisturbed area: Indians cultivate marijuana on the nearby escarpment, and may hunt around the lake.
Waterfowl: Apparently very poor for waterfowl, but *Jabiru mycteria* has been reported in the area.
Other fauna: Abercrombie *et al* found a number of *Crocodylus moreletii* in the area in 1978, and local inhabitants estimated the population at hundreds.
Threats: None known.
Research and conservation: Abercrombie *et al* surveyed the lake in 1978, and Dora Weyer, Ford Young and Martin Meadows conducted two aerial surveys in 1984.
References: Abercrombie *et al* (1980).
Source: Dora Weyer.
Criteria for inclusion: 2a & 3a.

Punta Ycacos Lagoon (17)

Location: 16°15'N, 88°40'W; 20 km northeast of Punta Gorda, Toledo District.
Area: 9,000 ha.
Altitude: 0m.
Province and type: 8.1.1; 01, 02, 03, 05, 08 & 09.
Site description: A large shallow sea bay incorporating the mouths of the Rio Grande, Seven Hills Creek, Middle River, Golden Stream, Deep River, Freshwater Creek and Payne's Creek. The salinity in the bay varies from slightly brackish at the river mouths in the west to saline in

the east. There are almost a hundred small to medium-sized mangrove covered cays in the bay, and extensive mangrove swamps and grass and sedge marshes along its western fringe. Four sand and coral cays (the Snake Cays) lie just outside the bay.
Principal vegetation: Mangrove swamps, and grass and sedge marshes.
Land tenure: State owned.
Protection: None.
Land use: A considerable amount of fishing; and illegal hunting of waterfowl and manatees, particularly by fishermen from nearby Guatemala.
Waterfowl: In previous years the mangrove cays supported a large breeding colony of *Egretta alba*, and a pair of *Jabiru mycteria* were found nesting in the early 1970s. Both have now disappeared, presumably as a result of persecution.
Other fauna: There is still a small population of the manatee *Trichechus manatus*, despiteheavy hunting pressure.
Threats: Heavy hunting pressure on all wildlife has resulted in drastic declines in populations in recent years.
Research and conservation: A number of avifaunal surveys were conducted by Dora Weyer and Ford Young between 1969 and 1984. The area now supports little wildlife, but the habitat remains relatively undisturbed, and under proper protection populations would soon recover.
Source: Dora Weyer.
Criteria for inclusion: 2a & 3a.

The upper Moho River, Aguacaliente Swamp and Mafredi Lagoon (18)

Location: 16°11'N, 88°58'W; east and south of Mafredi village, 18 km WNW of Punta Gorda, Toledo District.
Area: c.1,600 ha.
Altitude: 200m.
Province and type: 8.1.1; 10, 12 & 18.
Site description: A complex of fast-flowing rivers, freshwater lakes and swamps, and extensive tracts of swamp forest; subject to seasonal flooding. Parts of the marshes are now cultivated for rice.
Principal vegetation: Freshwater marshes, swamp forest, pure stands of *Lonchocarpus* sp, wild cane, bamboo and rice fields.
Land tenure: Various; Mafredi Lagoon and much of the flooded area is state owned.
Protection: None.
Land use: Subsistence hunting by local Indians; rice growing east and south of Mafredi, south of Blue Creek and east and northeast of Aguacate. Much of the area is difficult of access and almost undisturbed.
Waterfowl: There are no large breeding colonies of Ciconiiformes, but many species occur in fair numbers, and *Jabiru mycteria, Dendrocygna autumnalis, Cairina moschata* and *Aramus guarauna* have been recorded.
Other fauna: *Tapirus bairdii* is abundant, and the Central American Snapping Turtle *Chelydra serpentina* occurs. The latter is known in Belize only from this region.
Threats: There is an increase in agriculture, and refugees are pouring into the area and clearing for slash and burn agriculture. There is also excessive hunting by the local Indians.
Research and conservation: Dora Weyer has conducted five avifaunal surveys of parts of the area, but further field study is urgently required.
Source: Dora Weyer.
Criteria for inclusion: 2a & 3a.

The lower Temash River and Temash Lagoon (19)

Location: 16°00'N, 89°00'W; 25 km WSW of Punta Gorda, Toledo District.
Area: Uncertain, but probably at least 20,000 ha of mangroves and 35 km of river.
Altitude: 0m.
Province and type: 8.1.1; 07, 08 & 09.

Site description: A very deep brackish coastal lagoon, subject to tidal influence, and extensive tracts of mangrove swamp stretching for over 30 km inland along the lower Temash River.
Principal vegetation: Mangrove swamps dominated by *Rhizophora mangle*, with trees up to 30m in height.
Land tenure: State owned.
Protection: None.
Land use: Fishing in the lagoon, and some hunting.
Waterfowl: Poorly known; no large breeding colonies of Ciconiiformes have been located, but a variety of species occur, including *Nyctanassa violacea* and possibly *Tigrisoma lineatum*. The area appears very suitable for *Aramides axillaris*.
Other fauna: Little information is available, but there are known to be large numbers of the Black Howler Monkey *Alouatta palliata* in the area.
Threats: None at present, other than hunting and fishing.
Research and conservation: One brief avifaunal survey has been conducted by Dora Weyer. This large unspoiled area clearly merits further study.
Source: Dora Weyer.
Criteria for inclusion: 0.

COSTA RICA

Area: 50,899 km^2
Population: 2,270,000.

We have received no introduction to this inventory from our correspondents in Costa Rica.

WETLANDS

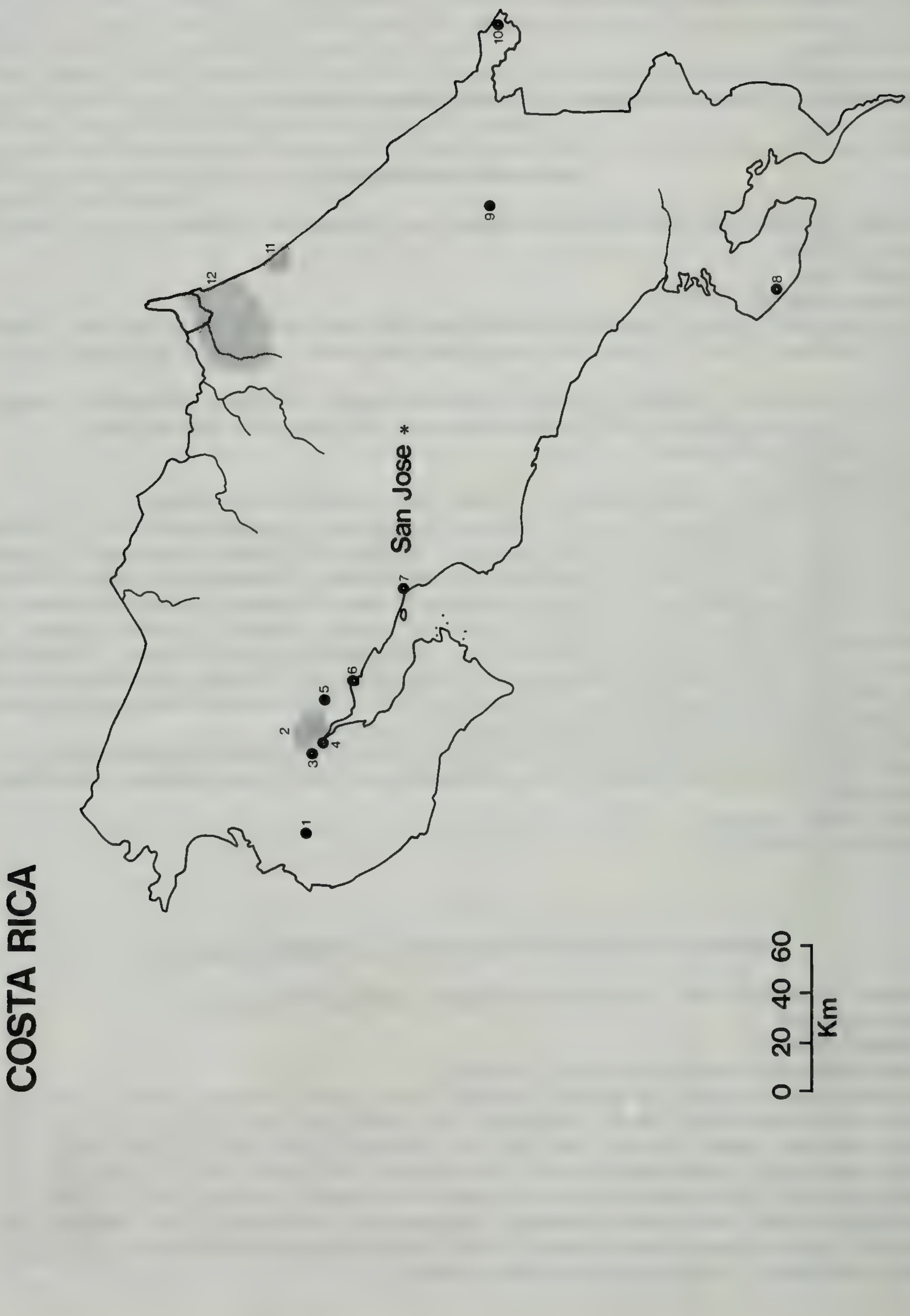
Site descriptions based on data sheets provided by Julio E. Sanchez.

Lagunas del Rio Cañas (1)

Location: 10°20'N, 85°37'W; 6 km NNW of Santa Cruz, Guanacaste Province.
Area: 1,000 ha.
Altitude: 60m.
Province and type: 8.16.4; 12.
Site description: A group of permanent freshwater lakes and marshes, up to 1m deep, formed by the flooding of the Rio Cañas and local rainfall, and greatly reduced in size during the dry season.
Principal vegetation: Floating beds of *Nymphaea ampla, N. lutea, Eichhornia crassipes* and *Pistia stratiotes*; marshes with *Typha domingensis*. In a region dry tropical forest.
Land tenure: Privately owned.
Protection: None.
Land use: Subsistence fishing, some sport fishing, and extensive cattle ranching.
Waterfowl: A very important area for breeding, passage and wintering waterfowl. Breeding birds include 50 pairs of *Podilymbus podiceps*, 25 pairs of *Podiceps dominicus*, 10 pairs of *Ixobrychus exilis*, 15 pairs of *Tigrisoma lineatum*, 30 pairs of *Butorides virescens*, 200 pairs of *Dendrocygna autumnalis*, 40 pairs of *Aramus guarauna*, 25 pairs of *Rallus maculatus*, 40 pairs of *Porphyrula martinica* and 300 pairs of *Jacana spinosa*. Average counts of non-breeding visitors include *500 Bubulcus ibis, 100 Egretta thula, 500 E. alba, 250 Mycteria americana* and 30 *Himantopus himantopus*. Average counts of Nearctic migrants include *12 Ardea herodias, 40 Anas americana, 300 Anas discors, 50 Tringa flavipes, 100 Tringa solitaria, 45 Actitis macularia, 160 Calidris minutilla* and 140 *C. melanotos*.
Other fauna: *Pandion haliaetus* is a common winter visitor, and *Caiman crocodilus* occurs.
Threats: The area is being drained for rice cultivation, and there is some pollution. Hunting is uncontrolled.
Source: Julio E. Sanchez.
Criteria for inclusion: 3a.

Wetlands in Palo Verde National Park and Wildlife Refuge (2)

Location: 10°20'N, 85°20'W; 20 km south of Bagaces, Guanacaste Province.
Area: c.6,000 ha.
Altitude: 2-10m.
Province and type: 8.16.4; 02, 08, 09, 12, 16 & 18.
Site description: A complex of shallow freshwater lakes, up to 1.5m deep, marshes and swamp forest in the floodplain of the Rio Tempisque, with some mangrove swamps along the river. During the rainy season, flooding from the Rio Tempisque forms a single large shallow lake. Large areas dry out by the end of the dry season (March and April), and the permanent lakes become brackish. The principal lakes are Laguna Palo Verde, a seasonal lake of 1,200 ha in the Wildlife Refuge, and Laguna Nicaragua, a seasonal lake of 4,100 ha in the National Park. There are two mangrove covered islands, Isla San Pablo (15 ha) and Isla Pajaros (2 ha), in the estuarine portion of the river subject to tidal influence.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Principal vegetation: Abundant aquatic vegetation including floating beds of *Nymphaea ampla N. lutea, Nymphoides* sp and *Eichhornia crassipes*; marshes of *Typha domingensis, Eleocharis mutata, Paspalum paludivagum* and *Parkinsonia aculeata*; swamp forest; and mangrove swamps with *Avicennia germinans* and *Rhizophora mangle.* In the dry tropical forest zone.
Land tenure: State owned.
Protection: Included within the Palo Verde National Park (9,466 ha) established in 1980, and the contiguous Palo Verde (Dr Rafael Lucas Rodriguez Caballero) National Wildlife Refuge (7,524 ha) established in 1979.
Land use: Scientific research and some nature tourism. Access is restricted to certain areas. There is some illegal grazing of domestic livestock.
Waterfowl: An extremely important area for breeding, passage and wintering waterfowl; over sixty species have been recorded. There are important breeding colonies of Ciconiiformes on Isla Pajaros and Isla San Pablo; the average numbers of nesting pairs during the years 1981 to 1983 were as follows: *Nycticorax nycticorax 250; Nyctanassa violacea 100; Cochlearius cochlearius 210; Bubulcus ibis 17,500; Egretta caerulea 50; E. thula 250; E. alba 2,650; Mycteria americana 3,000; Eudocimus albus 1,000; Plegadis falcinellus 12; and Ajaia ajaja 1,000.* There were also some 90 pairs of *Anhinga anhinga.* Common breeding species elsewhere in the wetlands include *Podilymbus podiceps, Podiceps dominicus, Ixobrychus exilis, Tigrisoma mexicanum, Butorides virescens, Dendrocygna bicolor, D. autumnalis* (several hundred pairs), *Cairina moschata, Aramus guarauna, Rallus maculatus, Porphyrula martinica* and *Jacana spinosa.* The area is the main locality for *Jabiru mycteria* in Costa Rica, with eight breeding pairs in recent years. *Oxyura dominica* is present in small numbers and probably breeds.
The wetlands are also important as feeding areas for birds breeding elsewhere in the region, particularly during the dry season (February to March). Peak counts have included up to 1,000 *Ajaia ajaja*, 20,000 *Dendrocygna autumnalis* and 400 *Cairina moschata.* Common passage and wintering birds from the Nearctic include *Ardea herodias, Anas americana, A. acuta, A. discors* (up to 20,000), *A. clypeata, Porzana carolina, Fulica americana* and many shorebirds, particularly *Catoptrophorus semipalmatus, Tringa solitaria, Calidris mauri* and *C. minutilla.*
Other fauna: There is a small breeding population of *Rostrhamus sociabilis*, and *Pandion haliaetus* is a common winter visitor. Reptiles include *Crocodylus acutus, Caiman crocodilus* and *Iguana iguana.*
Threats: The wetlands are under serious threat from a variety of sources. Eutrophication is occurring at a rapid rate, and areas of open water and *Nymphaea* spp are being replaced by a dense growth of *Typha domingensis*, Cyperaceae and Gramineae. Pesticide run-off from nearby rice, cotton and sugar cultivation is causing a serious toxicity problem in the river. In 1982 and 1983, 40% of the trees on Isla Pajaros died, and many nesting sites were destroyed. The largest irrigation project in Costa Rica is soon to be initiated nearby, and there is a proposal to exclude Laguna Nicaragua from the National Park so that it can be drained for the cultivation of sugar cane.
Research and conservation: A considerable amount of faunal and floral research has been conducted in the Wildlife Refuge. A detailed management plan has been prepared for the Refuge, and some management has been implemented, including the cutting, burning and clearing of excess vegetation, construction of artificial impoundments, and erection of nest-boxes for *Dendrocygna autumnalis.* However, it is clear that unless better control is gained of the quantity and quality of the water entering the wetlands, much of the importance of this unique area will be lost.
References: Stiles & Smith (1977); Leber (1980); IUCN (1982); Vaughan *et al* (1982).
Source: Julio E. Sanchez.
Criteria for inclusion: 123.

Laguna Mata Redonda (3)

Location: 10°19'N, 85°25'W; 20 km north of Nicoya, Guanacaste Province.
Area: 900 ha.
Altitude: 30m.
Province and type: 8.16.4; 12.

Site description: A seasonal freshwater lake, up to 2m deep, on the south bank of the Rio Tempisque, surrounded by pastureland. The lake is at its most extensive between August and October, and dries out completely in March and April.
Principal vegetation: Floating *Eichhornia crassipes, Nymphaea ampla, N. lutea, Nymphoides*sp and *Pontederia* sp; emergent *Eleocharis* spp, *Thalia geniculata* and *Ipomoea carnea.*
Land tenure: State owned.
Protection: None.
Land use: Cattle ranching and hunting.
Waterfowl: A very important feeding area for waterfowl during the early part of the dry season (January to mid March), with almost the same species as the nearby Palo Verde lakes. Concentrations at this time have included up to 5,000 *Mycteria americana*, 1,000 *Ajaia ajaja*, 20,000 *Dendrocygna autumnalis*, 20,000 *Anas discors* and 500 *Aramus guarauna.* Some 75 pairs of the latter also breed. The lake is one of the main feeding areas of the *Jabiru mycteria* breeding at the Palo Verde lakes.
Other fauna: About 10 pairs of *Rostrhamus sociabilis* breed. The freshwater turtle *Kinosternon scorpioides* is abundant, but *Caiman crocodilus* now occurs in much reduced numbers as a result of excessive persecution. There is an endemic bivalve *Nephronais tempisquensis* in the area.
Threats: The main threats are contamination with pesticides from nearby areas of rice cultivation; the future construction by the government of dykes and canals to regulate water levels; and uncontrolled hunting of ducks.
Research and conservation: The lake clearly merits protection as an important component of the Palo Verde wetland complex.
Source: Julio E. Sanchez.
Criteria for inclusion: 1a, 1b, 2a & 2c.

Laguna Zonzapote and Corral de Piedra (4)

Location: 10°15'N, 85°18'W; 20 km northeast of Nicoya, Guanacaste Province.
Area: 2,800 ha.
Altitude: 2m.
Province and type: 8.16.4; 12.
Site description: A seasonal fresh to brackish lake on the south bank of the Rio Tempisque, south of the Palo Verde lakes. The lake becomes brackish as the water level falls, and is completely dry from February to April.
Principal vegetation: Floating *Eichhornia crassipes, Nymphaea ampla* and *N. lutea*; emergent *Eleocharis mutata, Thalia geniculata* and *Typha domingensis.*
Land tenure: Privately owned.
Protection: None.
Land use: Cattle ranching, hunting, and some fishing and harvesting of shrimps.
Waterfowl: An important breeding area for resident waterfowl, and a very important wintering area for a variety of migrants. Breeding species include *Podilymbus podiceps* (up to 100 pairs), *Podiceps dominicus, Tigrisoma mexicanum, Nycticorax nycticorax, Cochlearius cochlearius* (40 pairs), *Dendrocygna bicolor, D. autumnalis, Aramus guarauna* (30 pairs), *Porphyrula martinica, Jacana spinosa, Charadrius wilsonius* and *Himantopus himantopus* (15 pairs). Concentrations of non-breeding birds and Nearctic migrants have included up to *2,000 Egretta thula, 6,000 Mycteria americana, 2,000 Eudocimus albus, 75 Plegadis falcinellus, 1,000 Ajaia ajaja, 400 Anas americana, 4,000 A. discors, 100 A. clypeata and 5,000* shorebirds.
Other fauna: Eight pairs of *Rostrhamus sociabilis* breed, and up to 6 *Pandion haliaetus* have been observed in winter. *Crocodylus acutus* and *Caiman crocodilus* occur.
Threats: The main threats are contamination with pesticides, drainage for the cultivation of rice, and uncontrolled hunting.
Source: Julio E. Sanchez.
Criteria for inclusion: 1b & 3a.

Estero Madrigal (5)

Location: 10°17'N, 85°09'W; 30 km SSE of Bagaces, Guanacaste Province.
Area: 300 ha.
Altitude: 10m.
Province and type: 8.16.4; 09, 11 & 18.
Site description: A wide stretch of slow-flowing river with riverine marshes and swamp forest, draining out through a narrow channel, and constituting one of the few permanently flooded wetlands in the Rio Tempisque valley. The river is up to 6m deep, and water levels remain fairly constant.
Principal vegetation: Floating beds of *Eichhornia crassipes* and *Pistia stratiotes*; marshes with *Typha domingensis, Thalia geniculata* and *Mimosa* sp; swamp forest with *Anacardium excelsum* predominating. Surrounded by pastureland and cultivated areas with rice and sugar cane.
Land tenure: Privately owned.
Protection: No legal habitat protection, but one of the landowners protects his property.
Land use: Hunting; cattle ranching and agriculture in surrounding areas.
Waterfowl: An important breeding area for waterfowl, and a very important refuge at the end of the dry season, when most other wetlands in the area have dried out. Breeding species include *Phalacrocorax olivaceus* (1,000 pairs in February 1985), *Tigrisoma mexicanum* (30 pairs), *Cochlearius cochlearius* (15 pairs), *Bubulcus ibis* (500 pairs), *Egretta alba* (100 pairs), *Mycteria americana* (100 pairs), *Jabiru mycteria* (1 pair in 1983), *Dendrocygna autumnalis* (250 pairs), *Cairina moschata* (5-10 pairs) and *Aramus guarauna* (20 pairs). These and other species breeding in the Rio Tempisque valley concentrate in large numbers in this area during the dry season, along with many Nearctic Anatidae and shorebirds.
Other fauna: *Rostrhamus sociabilis* and *Busarellus nigricollis* are common inthe dry season, and *Caiman crocodilus* occurs.
Threats: The main threats are contamination with pesticides, drainage for the cultivation of rice and sugar cane, and uncontrolled hunting.
Source: Julio E. Sanchez.
Criteria for inclusion: 2c & 3a.

Estero Piedras (6)

Location: 10°08'N, 85°03'W; 30 km south of Cañas, Guanacaste Province.
Area: Several hundred ha.
Altitude: 0-1m.
Province and type: 8.16.4; 07 & 08.
Site description: A complex of shallow brackish coastal marshes and mangrove swamps, partly seasonal and partly tidal, and an area of salt pans (Salina Bonilla).
Principal vegetation: Mangrove swamps; and brackish marshes with Cyperaceae, principally *Fimbristylis* sp.
Land tenure: A mixture of state and private ownership.
Protection: No special protection, but there is a general law which prohibits the cutting of mangroves.
Land use: Salt extraction and a little illegal cutting of mangroves.
Waterfowl: An important feeding area for birds breeding on Isla Pajaros to the northwest, and a very important passage and wintering area for migratory shorebirds and Laridae. Feeding concentrations have included up to 500 *Egretta alba*, 800 *Mycteria americana*, 600 *Eudocimus albus*, 300 *Ajaia ajaja* and 300 *Himantopus himantopus*. *Charadrius wilsonius* breeds. Common passage and wintering birds include *Egretta caerulea, E. tricolor, Ardea herodias*, many shorebirds (notably *Pluvialis squatarola, Charadrius semipalmatus, Numenius phaeopus, Catoptrophorus semipalmatus, Actitis macularia, Limnodromus griseus, Calidris* spp and *Micropalama himantopus*), *Larus atricilla, Sterna hirundo* and *S. albifrons*.
Other fauna: *Pandion haliaetus* is a winter visitor.
Threats: Road construction through the wetland has affected the hydrology of the marshes; large areas of mangroves were destroyed in the construction of 405 ha of shrimp ponds at Chomes; the illegal cutting of mangroves continues; and there is uncontrolled hunting.

Research and conservation: Some shorebirds have been banded at Salina Bonilla.
References: Stiles & Smith (1977).
Source: Julio E. Sanchez.
Criteria for inclusion: 3a.

Estero Mata de Limon (7)

Location: 9°55'N, 84°42'W; near Barranca, Puntarenas Province.
Area: 200 ha.
Altitude: 0m.
Province and type: 8.16.4; 07 & 08.
Site description: A complex of brackish coastal lagoons, up to 2m deep, brackish marshes and mangrove swamps, partly seasonal and partly tidal.
Principal vegetation: Mangrove swamps, and brackish marshes.
Land tenure: A mixture of state and private ownership.
Protection: No special protection, but there is a general law which prohibits the cutting of mangroves.
Land use: Recreation and salt extraction.
Waterfowl: A feeding area for *Phalacrocorax olivaceus* and various Ciconiiformes, and an important passage and wintering area for migratory shorebirds and Laridae, with almost the same species as Estero Piedras (site 6).
Other fauna: No information.
Threats: The construction of dykes has affected the hydrology of the wetland; mangroves have been destroyed and replaced with salt pans; and there is a potential threat of pollution from a nearby harbour, currently under construction.
Source: Julio E. Sanchez.
Criteria for inclusion: 3a.

Laguna Corcovado (8)

Location: 8°33'N, 83°36'W; 40 km west of Puerto Jimenez, Puntarenas Province.
Area: 1,200 ha.
Altitude: 10m.
Province and type: 8.16.4; 12 & 18.
Site description: A permanent freshwater lake, up to 4m deep, surrounded by marshes, palm swamps and swamp forest, and with a river channel passing through it. The water level fluctuates considerably, and extensive flooding occurs during the rainy season.
Principal vegetation: Extensive marshes with Gramineae, mainly *Pennisetum* sp, which covers the greater part of the lake; large tracts of the palm *Raphia taedigera*; and swamp forest with *Pterocarpus officinalis, Inga vera, Euterpe* sp and *Cecropia* spp. In a region of very humid tropical forest.
Land tenure: State owned.
Protection: Included within the Corcovado National Park (36,000 ha) established in 1976.
Land use: None; much of the area is very difficult of access.
Waterfowl: A very rich area for both breeding and wintering waterfowl; fifty species have been recorded, but no census data are available. Resident species include *Podiceps dominicus, Anhinga anhinga, Ixobrychus exilis, Nycticorax nycticorax, Nyctanassa violacea, Cochlearius cochlearius, Agamia agami, Mycteria americana, Eudocimus albus, Ajaia ajaja, Cairina moschata, Aramus guarauna, Amaurolimnas concolor, Aramides cajanea, Porphyrula martinica* and *Jacana spinosa.* Passage and wintering species include *Ardea herodias, Anas discors* and many Nearctic shorebirds.
Other fauna: *Pandion haliaetus* is a winter visitor, and *Caiman crocodilus* occurs.
Threats: None known.
Research and conservation: A considerable amount of research is being conducted on the fauna and flora of the National Park, and a Master Plan has been produced.

References: Vaughan (1981); IUCN (1982).
Source: Julio E. Sanchez.
Criteria for inclusion: 3a.

Lago Dabagri (9)

Location: 9°37'N, 83°16'W; 90 km ESE of San Jose, Limon Province.
Area: 25 ha.
Altitude: 1,000m.
Province and type: 8.16.4; 12 & 18.
Site description: A permanent freshwater lake, c.5m deep, surrounded by marshes, wet grassland and flooded forest; in the highlands, on the Caribbean slope of the Cordillera de Talamanca.
Principal vegetation: Cyperaceae swamps; and flooded forest.
Land tenure: State owned.
Protection: Included within La Amistad National Park (192,000 ha) established in 1979.
Land use: None; there are several Indian Reservations near the lake.
Waterfowl: Very poorly known. Waterfowl observed during a single visit in 1981 included *Podiceps dominicus, Butorides virescens, Porphyrula martinica* and *Jacana spinosa.*
Other fauna: No information.
Threats: None known.
Source: Julio E. Sanchez.
Criteria for inclusion: 3a.

Laguna Gandoca (10)

Location: 9°35'N, 82°36'W; on the Caribbean coast near the Panamanian border, Limon Province.
Area: 780 ha.
Altitude: 0-2m.
Province and type: 8.16.4; 05, 07 & 18.
Site description: A brackish coastal lagoon of 30 ha, up to 6m deep, subject to tidal influence; two nearby marshes; adjacent flooded forest; and sandy beaches.
Principal vegetation: Flooded forest and extensive tracts of the palm *Schelia rostrata.* In a region of humid tropical forest.
Land tenure: Mainly state owned, with some private ownership.
Protection: None.
Land use: Fishing and hunting; cultivation of cocoa and some cattle ranching nearby.
Waterfowl: Very poorly known. *Pelecanus occidentalis* is common, and is reported to breedon a small island nearby (Punta Mona). A variety of Ardeidae, Nearctic shorebirds and Laridae were observed during two brief visits to the lagoon, but the marsh areas have never been investigated.
Other fauna: The manatee *Trichechus manatus* occurs in the area; and the adjacent humid tropical forests have an extremely diverse fauna.
Threats: The native forests are being destroyed for the cultivation of an African palm, and this is likely to affect the wetland ecosystem.
Research and conservation: The area is difficult of access, and remains very poorly known. The Asociacion de Desarrollo has presented a proposal to the Government for the establishment of a protected area, but no decision has as yet been taken.
Source: Julio E. Sanchez.
Criteria for inclusion: 2a & 3a.

Wetlands in Tortuguero National Park (11)

Location: 10°25'N, 83°27'W; 30 km NNE of Siquirres, Limon Province.
Area: 15,000 ha.
Altitude: 0-5m.
Province and type: 8.16.4; 05, 08, 13, 16 & 18.
Site description: A vast complex of palm swamps and fresh to brackish marshes crossed by many narrow channels; a large area of seasonally flooded grassy marshes; and some mangrove swamps behind a long sea beach.
Principal vegetation: Floating beds of *Eichhornia crassipes*; marshes with Gramineae and Cyperaceae; palm swamps with *Raphia taedigera*; mangrove swamps with *Rhizophora mangle*; and beach vegetation with *Coccoloba uvifera*. In a region of humid tropical forest, with very high rainfall (5,000 mm) and no marked dry season.
Land tenure: State owned.
Protection: Within the Tortuguero National Park (18,947 ha) established in 1970.
Land use: None.
Waterfowl: A very important area for migratory Ardeidae and shorebirds. Shorebirds recorded in large numbers along the coast include *Pluvialis squatarola, Charadrius semipalmatus, C. collaris, Numenius phaeopus, Tringa melanoleuca, T. flavipes, T. solitaria, Catoptrophorus semipalmatus, Actitis macularia, Arenaria interpres, Limnodromus griseus, Calidris alba, C. pusilla, C. mauri* and *C. minutilla. Mesembrinibis cayennensis* is known to occur in the swamps.
Other fauna: The manatee *Trichechus manatus* is still thought to occur; and the sea turtles *Chelonia mydas, Eretmochelys imbricata* and *Dermochelys coriacea* nest along the beach.
Threats: The hunting of turtles and collection of their eggs are still a problem in the Park.
Research and conservation: General faunal and floral surveys have been conducted in the Park; a considerable amount of research has been carried out on the sea turtles; and a preliminary management plan has been prepared.
References: IUCN (1982).
Source: Julio E. Sanchez.
Criteria for inclusion: 2b & 3a.

Barra del Colorado (12)

Location: 10°32'-10°45'N, 83°32'-83°53'W; on the Caribbean coast near the Nicaraguan border, Limon and Heredia Provinces.
Area: 53,550 ha.
Altitude: 0-1m.
Province and type: 8.16.4; 05, 07, 09 & 12.
Site description: A vast complex of interconnected freshwater lakes and marshes, brackish coastal lagoons and marshes, and palm swamps, behind a long sandy beach. The lagoons near the coast are subject to tidal influence.
Principal vegetation: Freshwater lakes with floating beds of *Eichhornia crassipes*; marshes with Gramineae and Cyperaceae; and palm swamps with *Astrocarium olatum* and *Raphia taedigera*. In a region of humid tropical forest.
Land tenure: Privately owned.
Protection: None.
Land use: Commercial fishing; cattle ranching and agriculture nearby.
Waterfowl: A wide variety of breeding, passage and wintering waterfowl have been recorded, but no census data are available. Resident species include *Pelecanus occidentalis, Anhinga anhinga, Nycticorax nycticorax, Nyctanassa violacea, Mesembrinibis cayennensis, Aramides cajanea, Laterallus albigularis* and *Porphyrula martinica*. Migrants and wintering birds include *Ardea herodias, Anas discors, Aythya affinis, Fulica americana*, many Nearctic shorebirds, *Larus atricilla, Chlidonias nigra* and *Sterna hirundo*.
Other fauna: The manatee *Trichechus manatus* still occurs in the area. Fishes include *Lepisosteus tropicus*.
Threats: A road is being constructed through the region, and this will inevitably lead to accelerated exploitation of the natural ecosystems.
Research and conservation: A proposal has been made for the establishment of a National

Wildlife Refuge (Refugio Nacional de Fauna Silvestre) incorporating the wetland.
Source: Julio E. Sanchez.
Criteria for inclusion: 2a, 2b & 3a.

EL SALVADOR

INTRODUCTION

based on information provided by Carolina Calderon of the Embassy of El Salvador in London.

El Salvador, the smallest country in Central America, has an area of 21,200 km^2, and a population of almost five million. It is situated on the Pacific watershed and has a coastline of approximately 260 km. The terrain is very mountainous, and the country is crossed by a chain of volcanoes (e.g. Santa Ana, San Vicente, San Miguel and San Salvador), some of which are still active. These mountains separate the Pacific coastal plain in the south from the plain of the Rio Lempa in the north. The Rio Lempa is the main river in El Salvador; it cuts through the mountain chain and eventually flows into the Golfo de Fonseca.

The rainy season extends from May until October, and temperatures are uniformly high.

Institutional Base for Wetland Conservation and Research

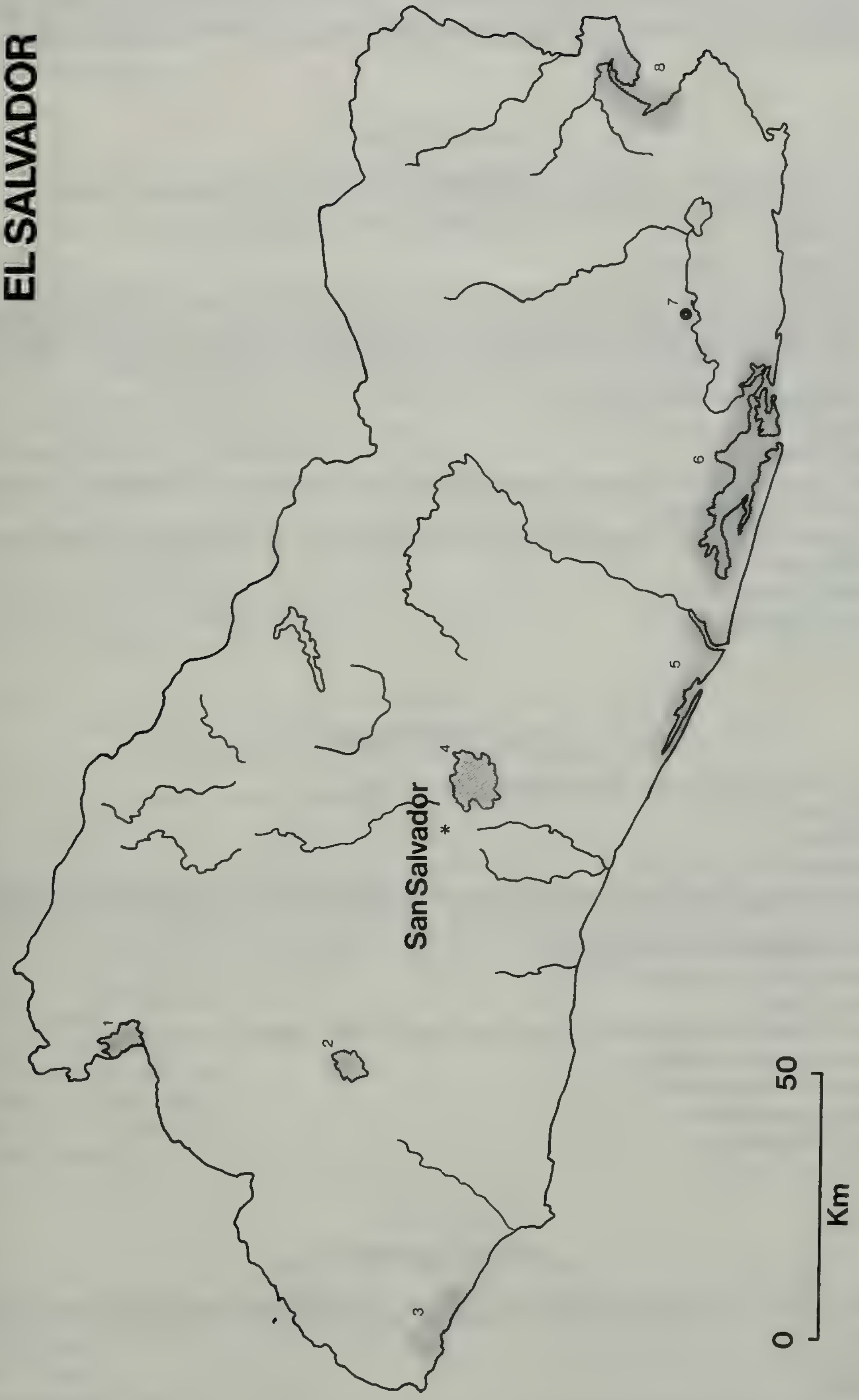
The principal bodies concerned with environmental conservation and research are as follows:

Direccion General de Recursos Naturales Renovables, the government agency responsible for the conservation of nature and research.
Instituto Salvadoreño de Turismo (El Salvador Tourist Institute), which cooperates in projects concerned with nature protection.
Parque Zoologico Nacional, dedicated to environmental education and research.
Museo de Historia Natural, dedicated to research and education.

Progress in Wetland Conservation and Research

No National Parks or equivalent reserves have as yet been officially protected by law in El Salvador, but some zones are managed as such, for example the Parque Nacional Cerro Verde (500 ha), the Parque Nacional Walter Thilo Deininger (732 ha), the Refugio Faunistico Laguna Jocotal (1,000 ha), Barra de Santiago, and Bosque El Impossible.

Research currently in progress includes a study of the reproductive biology of *Dendrocygna autumnalis* at Laguna Jocotal by Jose A. Gomez Ventura, and research on sea turtles at Barra de Santiago by Manuel F. Benitez Arias.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WETLANDS

No data sheets were received from El Salvador. The site descriptions are based on personal communication with Manuel F. Benitez Arias and Jose A. Gomez Ventura, and the meagre literature.

Laguna de Guija (1)

Location: 14°15'N, 88°32'W; 30 km north of Santa Ana, on the Guatemalan border.
Area: 4,300 ha, of which 3,000 ha are in El Salvador.
Altitude: 427m.
Province and type: 8.16.4; 12.
Site description: A large freshwater lake with several small islands and fringing marshes; in the mountains of northwestern El Salvador, on the Guatemalan border. A new hydroelectric dam at the lake's outlet generates electricity for the western part of the country. (See Guatemala site 6).
Principal vegetation: No information.
Land tenure: No information.
Protection: None.
Land use: Generation of electricity; cattle ranching and agriculture in surrounding areas.
Waterfowl: No information.
Other fauna: The fish fauna includes endemic species of Poecilidae, particularly of the genus *Heterandria.*
Threats: No information.
Criteria for inclusion: 0.

Lago de Coatepeque (2)

Location: 13°52'N, 89°33'W; 15 km south of Santa Ana.
Area: 2,200 ha.
Altitude: 850m.
Province and type: 8.16.4; 12.
Site description: A freshwater caldera lake with a small island; on the slopes of Volcan de Santa Ana.
Principal vegetation: No information.
Land tenure: No information.
Protection: None.
Land use: Fishing and recreation. There are many houses around the lake.
Waterfowl: No information.
Other fauna: No information.
Threats: No information.
Criteria for inclusion: 0.

Barra de Santiago (3)

Location: 13°42'N, 90°00'W; on the coast 30 km west of Sonsonate, in extreme western El Salvador.
Area: 4,800 ha.
Altitude: 0m.
Province and type: 8.16.4; 05, 07 & 08.
Site description: A chain of small brackish lagoons, marshes and mangrove swamps behind a sea beach.
Principal vegetation: Mangrove swamps.
Land tenure: No information.

Protection: None.
Land use: No information.
Waterfowl: No information.
Other fauna: The beaches are an important nesting area for sea turtles.
Threats: No information.
Research and conservation: M. F. Benito Arias is conducting research on the sea turtles.
Criteria for inclusion: 0.

Lago de Ilopango (4)

Location: 13°40'N, 89°13'W; 15 km east of San Salvador.
Area: 6,600 ha.
Altitude: 450m.
Province and type: 8.16.4; 12.
Site description: A deep freshwater lake in a volcanic crater in the mountains close to San Salvador city. In 1880, geological disturbance resulted in the appearance of an island in the lake, and a lowering in water level. The channel draining the lake has since become blocked, and the water level has risen again.
Principal vegetation: No information.
Land tenure: No information.
Protection: None.
Land use: A popular area for recreation, including water sports.
Waterfowl: No information.
Other fauna: No information.
Threats: Some pollution has been reported.
Criteria for inclusion: 0.

Rio Lempa estuary and coastal lagoons (5)

Location: 13°17'N, 88°50'W; 60 km southeast of San Salvador.
Area: 11,000 ha.
Altitude: 0m.
Province and type: 8.16.4; 02, 05, 07 & 08.
Site description: The estuary of the Rio Lempa, associated coastal marshes and mangrove swamps, and a long narrow coastal lagoon to the west, with sand beaches along the coast.
Principal vegetation: Mangrove swamps.
Land tenure: No information.
Protection: None.
Land use: No information.
Waterfowl: No information.
Other fauna: No information.
Threats: No information.
Criteria for inclusion: 0.

Punta San Juan lagoons (6)

Location: 13°10'-13°18'N, 88°16'-88°45'W; 40 km southwest of San Miguel.
Area: 37,000 ha.
Altitude: 0-10m.
Province and type: 8.16.4; 05, 07 & 08.
Site description: An extensive system of brackish coastal lagoons with mangrove swamps, and adjacent sand beaches.
Principal vegetation: Mangrove swamps.
Land tenure: No information.

Protection: None.
Land use: Shrimp farming.
Waterfowl: No information.
Other fauna: No information.
Threats: No information.
Criteria for inclusion: 0.

Laguna Jocotal (7)

Location: 13°19'N, 88°15'W; 17 km SSW of San Miguel, Department of San Miguel.
Area: 1,200 ha at maximum level.
Altitude: 20m.
Province and type: 8.16.4; 12 & 18.
Site description: A permanent freshwater lake, up to 3m deep, and marshes, to the north of the Rio Grande de San Miguel, and at the base of San Miguel Volcano. The lake is eutrophic, and most of the surface is covered with floating vegetation. There is a relict patch of swamp forest to the east of the lake. Water levels fluctuate widely; during the rainy season, the Rio Grande overflows and floods upto 1,200 ha; during the dry season the lake is reduced to 500 ha.
Principal vegetation: Submergent beds of *Hydrilla verticillata*, *Ceratophyllum demersum* and *Najas* sp; extensive floating beds of *Eichhornia crassipes* with some *Pistiastratiotes*, *Salvinia* sp and *Lemna* sp; emergent *Nymphaea ampla*; fringing marshes of *Phragmites communis*, *Typha angustifolia* and *Saggitaria lancifolia*; and some swamp forest. In the subtropical humid forest zone, but the forest around the lake has been cleared.
Land tenure: Mostly privately owned.
Protection: Within the Laguna Jocotal Wildlife Sanctuary (about 1,000 ha) established in 1978.
Land use: Fishing; agriculture (mainly cotton) and livestock grazing to the east. Three hundred families live around the lake.
Waterfowl: A very rich area for waterfowl, with a large breeding population of *Dendrocygna autumnalis*. Other common species include *Butorides virescens*, *Dendrocygna bicolor*, *Oxyura dominica* (up to 500 in winter), *Gallinula chloropus*, *Porphyrula martinica*, *Fulica americana*, *Jacana spinosa* and *Himantopus himantopus*.
Other fauna: No information.
Threats: The major threat is pesticide run-off from nearby cotton plantations.
Research and conservation: A considerable amount of research has been conducted on the flora and fauna of the lake, and particularly the waterfowl. M.F. Benitez Arias has studied the Rallidae, and J.A. Gomez Ventura is currently studying the *Dendrocygna autumnalis* population. The *Dendrocygna* population is being managed by the local inhabitants for food.
References: Benitez Arias (1981); IUCN (1982).
Source: See references.
Criteria for inclusion: 2b & 3a.

Golfo de Fonseca (8)

Location: 13°23'N, 87°52'W; in extreme southeastern El Salvador, on the Honduran border.
Area: 11,000 ha.
Altitude: 0m.
Province and type: 8.16.4; 02, 05, 06, 08 & 09.
Site description: The western extremity of the Golfo de Fonseca, the greater part of which lies in Honduras and Nicaragua. A vast estuarine system with intertidal mudflats, mangrove swamps and sandy beaches. (See Honduras site 5 and Nicaragua site 1).
Principal vegetation: Mangrove swamps.
Land tenure: No information.
Protection: None.
Land use: No information.

Waterfowl: No information, but presumably similar to Nicaragua site 1.
Other fauna: No information, but presumably similar to Honduras site 5 and Nicaragua site 1.
Threats: No information.
Criteria for inclusion: 0.

GUATEMALA

INTRODUCTION

based on information provided by Juan Carlos Godoy, Ruben Velasquez and Luis M. Villar Anleu, and information extracted from Cabrera and Willink (1973) and USAC & INGUAT (1981)

Guatemala, with an area of 108,889 km^2 and a population of 7,500,000, has the highest population density of any country in Central America. It is crossed from west to east by three mountain chains which unite in a central massif. There are at least thirty-three volcanoes in the youngest chain; almost ten of these are currently active, and earthquakes and earth tremours are frequent. There are numerous rivers distributed in three watersheds; the Pacific, the Golf of Mexico (Atlantic), and the Caribbean (Atlantic). The country has 240 km of coast on the Pacific and 110 km on the Caribbean.
Guatemala can be divided into four physiographical regions:

a) The Pacific plain, some 50 km wide, characterized by high rainfall during the rainy season (May to October).
b) The Pacific cordillera, made up of the southern slopes of the central massif. The terrain is very rugged with dense, humid tropical vegetation.
c) The inner highlands, with numerous volcanoes and peaks up to 4,211m. The majority of the Guatemalan population lives in this region.
d) The lowlands of Peten-Caribe, a karst limestone region with abundant vegetation. The Peten subregion is a large plain in the north of the country, with maximum heights of 500m and dense tropical vegetation; the Caribbean subregion in the east has some mountain spurs and very humid tropical vegetation.

According to Cabrera and Willink (1973), two biogeographical provinces occur in Guatemala:

a) The Central American Montane Province in the Caribbean Domain, at the southern limit of the Holarctic Realm. This province, corresponding in Guatemala to Udvardy's Madrean-Cordilleran Province (1.21.12), is transitional between the Holarctic and Nearctic Realms; although it includes tree species belonging to Holarctic genera, most of the other forest elements are clearly Neotropical. The province occupies the interior highlands of the country.
b) The Pacific Province in the Amazonian Domain. This province, corresponding in Guatemala to Udvardy's Campechean (8.1.1) and Central American (8.16.4) Provinces, occupies both the Pacific and the Atlantic lowlands. It is characterized by high humidity and high temperatures. The dominant vegetation is humid tropical forest, with mangroves along the coasts.

The wetlands of Guatemala can be grouped into three categories:

a) Rivers, in some forty basins; most have short, rapid courses.
b) The great estuarine, coastal lagoon and canal system extending for some 100 km along the Pacific coast. This incorporates the deltas of several rivers of the Pacific watershed and has extensive mangrove swamps; it comprises a rich habitat for Ardeidae, Anatidae and other waterfowl.
c) Lakes and ponds, of which there are about 350 in the whole country, ranging in size from less than 1 ha to 58,960 ha (Lago de Izabal). The many small seasonal and permanent water bodies in the Department of Peten are particularly worthy of mention. They are known locally as "aguadas" and are characteristic formations of karstic limestone regions. They are of considerable importance to all forms of wildlife in the region.

Institutional Base for Wetland Conservation and Research

Governmental

The Instituto Nacional Forestal (INAFOR) is the body responsible by law for the administration of National Parks and some recreation areas, and also has jurisdiction over the country's wildlife.

The Instituto Guatemalteco de Turismo (INGUAT) actively participates in conservation and collaborates with CECON.

The Direccion General de Antropologia e Historia (DIGAHE) is responsible for the conservation of the national cultural heritage. It works in collaboration with INAFOR, and administers Tikal National Park and the World Heritage sites of Quirigua and Antigua Guatemala.

The Universidad de San Carlos de Guatemala (USAC) is dedicated to education at university level and research. It collaborates on conservation matters with INAFOR, DIGAHE, INGUAT and others.

The Centro de Estudios Conservacionistas (CECON), within the Universidad de San Carlos, is dedicated to environmental research, the conservation of nature and the management of Protected Biotopes. It produces official publications and has a programme of environmental education.

Non-governmental

Asociacion Guatemalteca de Historia Natural
Asociacion de Amigos del Bosque
Asociacion Defensores de la Naturaleza
Asociacion Pro-Defensa del Medio Ambiente

Progress in Wetland Conservation and Research

The first National Parks in Guatemala were established in 1955. The establishment of these National Parks and equivalent areas was the result of isolated symbolic actions, rather than a logical scheme to achieve conservation of natural and cultural resources.

At the present time, those wildlife areas which are being most effectively conserved and managed are the Protected Biotopes, administered by CECON with the collaboration of INGUAT, INAFOR, DIGAHE, Instituto Nacional de Transformacion Agraria (INTA) and Empresa de Desarrollo de el Peten (FYDEP). Of the four Biotopes currently in existence, three play an important role in the conservation of wetlands: Cerro Cahui (which includes areas of Lake Peten-Itza); Chocon-Machacas (which includes mangroves, lagoons and swamps on the Atlantic coast); and Monterrico (which includes part of the mangrove system of the Pacific coast).

Projects and research currently being conducted in relation to wetlands and waterfowl include the following:

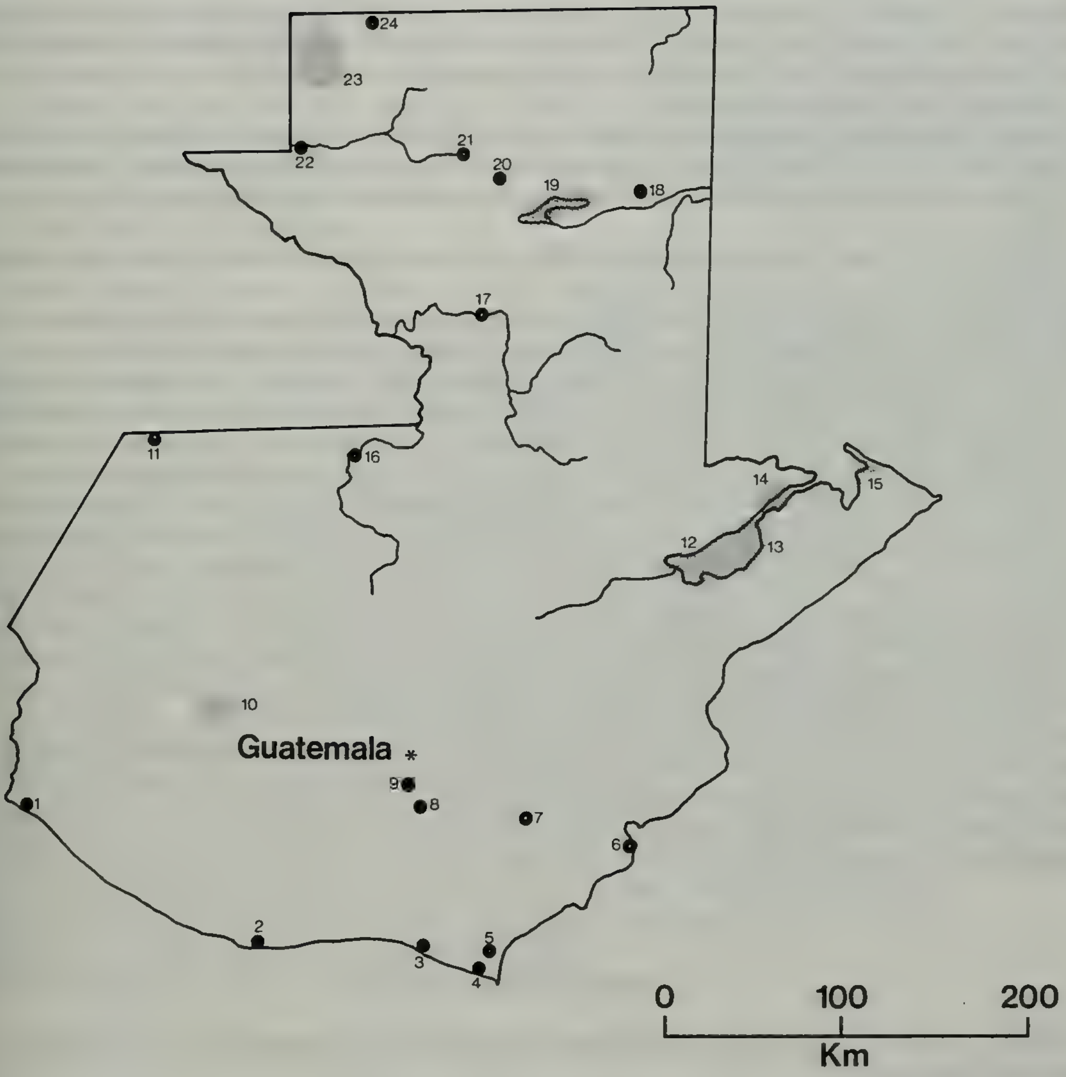
a) A project for the protection and possible captive breeding of *Podilymbus gigas* at Lake Atitlan, by CECON and INAFOR in collaboration with the U.S. Fish and Wildlife Service and World Wildlife Fund - U.S.
b) An inventory project entitled "Tierras Humedas y Vegetacion en Guatemala", directed by Juan Carlos Godoy (CECON).
c) A study of the biology and ecology of Anatidae in Guatemala, directed by Luis M. Villar Anleu (CECON).
d) A study of the biology and ecology of the Podicipediformes of Guatemala, directed by H. A. Kihn (CECON).

Major Threats to Wetlands and Waterfowl

The most imminent threats to wetlands in Guatemala include pollution from fertilizers, pesticides and human waste, and contamination with mineral residues, as is the case at Lago de Izabal. At lakes in the highlands, the most serious problems are increased sedimentation caused by soil erosion in deforested areas and the construction of houses on the lake shores.

Other important factors are the loss of habitat and illegal and uncontrolled hunting. Some lagoons of special importance for migratory waterfowl have been drained for agricultural use. There has recently been an increase in sport hunting, but this has not as yet been rationalized with respect to bag limits or to the type of weapons or methods that can be employed.

GUATEMALA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WETLANDS

Site descriptions based on data sheets provided by Luis M. Villar Anleu, Juan Carlos Godoy and Ruben Velasquez of the Centro de Estudios Conservacionistas (CECON).

Manchon Lagoons (1)

Location: 14°29'N, 92°03'W; on the Pacific coast 40 km west of Mazatenango, San Marcos Department.
Area: 13,850 ha.
Altitude: 0-4m.
Province and type: 8.16.4; 02, 05, 07, 08 & 09.
Site description: A large complex of interconnecting shallow brackish lagoons, up to 5m deep, mangrove swamps and marshes in the estuarine and delta systems of several small rivers; the principal river is the Rio Ococito. The lagoons are subject to tidal inundation near the coast and flooding from the rivers, the water level fluctuating by up to 2m. They are separated from the sea by a sand barrier 100m wide.
Principal vegetation: Mangrove swamps with *Rhizophora mangle, Laguncularia racemosa, Conocarpus erectus* and *Pachira aquatica*; marshes dominated by Gramineae and Cyperaceae.
Land tenure: Mainly owned by the state and local municipalities, but there are some private holdings.
Protection: The mangroves are protected by law, but this is not enforced. Otherwise the area is unprotected.
Land use: Fishing, pisciculture, shrimp farming, salt extraction, recreation and tourism. The lagoons are used for transportation, and there are housing developments in the area.
Waterfowl: A very important area for both resident and migratory waterfowl; over seventy species have been recorded. Common residents include *Pelecanus occidentalis, Phalacrocorax olivaceus*, a variety of Ardeidae, *Mycteria americana, Eudocimus albus, Dendrocygna autumnalis* (abundant), *Cairina moschata, Aramides cajanea, Fulica americana* and *Jacana spinosa*; other residents include *Tigrisoma mexicanum, Jabiru mycteria, Ajaia ajaja, Aramus guarauna, Heliornis fulica, Haematopus palliatus, Charadrius wilsonius* and *Himantopus himantopus*. A wide variety of Nearctic Anatidae and shorebirds occur on migration and in winter; the commoner species include *Anas americana, A. discors, Charadrius vociferus, Numenius phaeopus, Tringa solitaria, Catoptrophorus semipalmatus, Actitis macularia* and *Calidris mauri.*
Other fauna: There are important populations of Psittacidae in the area, and the crocodilians *Crocodylus acutus* and *Caiman crocodilus fuscus* occur in the lagoons.
Threats: There is excessive exploitation of all natural resources in the area, and intensive use of pesticides, including D.D.T., in the watersheds of the five main rivers entering the lagoons.
Research and conservation: CECON has conducted faunal and floral surveys, and prepared a proposal for the establishment of appropriate reserves and protected areas.
Source: Luis M. Villar Anleu and Juan Carlos Godoy.
Criteria for inclusion: 2b & 3a.

Rio Acome Estuary (2)

Location: 13°57'N, 91°05'W; on the Pacific coast, 90 km southwest of Guatemala City, Escuintla Department.
Area: 3,100 ha.
Altitude: 0-1m.
Province and type: 8.16.4; 05, 07 & 08.
Site description: The small estuary of the Rio Acome with mangrove swamps, brackish marshes and adjacent coastal sand dunes.
Principal vegetation: Mangrove swamps and sand dune vegetation.
Land tenure: Mainly under private ownership, with some parts state owned.
Protection: No effective protection although the area has been designated as a "Parque Nacional Lineal".

Land use: Cattle ranching, and cultivation of cotton, sugar, some rice and some maize, in the surrounding areas.
Waterfowl: Similar to Manchon Lagoons (site 1), but with more Ardeidae and fewer Anatidae.
Other fauna: No information.
Threats: Contamination with pesticides, and expansion of pasture land and agriculture.
Source: Luis M. Villar Anleu and Juan Carlos Godoy.
Criteria for inclusion: 0.

Monterrico Lagoons (3)

Location: 13°54'N, 90°28'W; 15 km south of Taxisco, Santa Rosa Department.
Area: 4,325 ha.
Altitude: 0.6-1.5m.
Province and type: 8.16.4; 05, 07, 08, 09 & 18.
Site description: A coastal belt of small estuaries, brackish lagoons and marshes about 2 km wide, bordered on the seaward side by sand beaches. The principal river is the Rio Maria Linda. There are large areas of seasonally flooded marshes, shallow seasonal lagoons, and mangrove swamps along the major tidal channels. The salinity in the marshes increases during the dry season (December to May). A narrow interrupted band of swamp forest borders the landward edge of the marshes and extends in a narrow riparian strip as gallery forest along the streams draining into the marshes.
Principal vegetation: Mangrove swamps with *Rhizophora mangle* and *Avicennia germinans*; other plants include *Laurus borbonica, Carapa guianensis, Myroxylum pereirae, Swietenia humilis, Sterculia cartaginensis, Ceiba aesculifolia, Lonchocarpus guatemalensis, Enterolobium cyclocarpum, Pithecolobium lanceolatum, Dalbergia cubilquitzensis, Gliricidia guatemalensis, Tabebuia penthaphylla, Bombax allipticum, Pachira aquatica, Coccoloba caracasana* and *Cynometra retusa*. There is dry tropical scrub forest inland from the marshes.
Land tenure: A mixture of state and private ownership, with some of the state owned lands leased to private individuals.
Protection: Part of the area was designated as a "Protected Biotope" in 1978, and has been well protected since then by CECON.
Land use: Fishing, shrimping, salt extraction, exploitation of mangroves for timber, transportation by boat, and recreation.
Waterfowl: Known to be a very rich area for a wide variety of waterfowl, particularly Ardeidae and Nearctic migrants, but little information available. During field work between 1968 and 1976, Dickerman recorded several species new for Guatemala including *Porzana flaviventer, Calidris bairdii* and *Sterna albifrons*. He also observed small groups of *Limosa haemastica* on spring migration.
Other fauna: The sea turtle *Chelonia mydas* nests of the beaches.
Threats: Human settlement in the area, with extensive utilization of the mangroves for construction and fuel; and the development of salt pans.
Research and conservation: Faunal and floral investigations have been conducted by CECON, and Dickerman carried out ornithological field work in 1968, 1973, 1974 and 1976.
References: Dickerman (1975 & 1977); Godoy (1981); Rodriguez (1981).
Source: Luis M. Villar Anleu and Juan Carlos Godoy.
Criteria for inclusion: 3a.

Rio Paz Estuary (El Jiote) (4)

Location: 13°49'N, 90°15'W; 30 km southeast of Taxisco, Santa Rosa Department.
Area: 1,300 ha.
Altitude: 0-0.4m.
Province and type: 8.16.4; 02, 05 & 08.
Site description: The estuary of the Rio Paz, with mangrove swamps and adjacent sand beaches.
Principal vegetation: Mangroves and sand dune vegetation.

Land tenure: Owned by the state and local municipality, with some lands leased to private individuals.
Protection: None.
Land use: Fishing, shrimping, exploitation of mangroves for timber, salt extraction, and recreation; plantations and cultivation nearby.
Waterfowl: Similar to sites 1, 2 and 3; particularly important for Ardeidae.
Other fauna: No information.
Threats: None known.
References: Godoy (1980).
Source: Juan Carlos Godoy.
Criteria for inclusion: 0.

Laguna Grande (5)

Location: 13°53'N, 90°11'W; 37 km ESE of Taxisco, Jutiapa Department.
Area: 270 ha.
Altitude: 35m.
Province and type: 8.16.4; 12.
Site description: A permanent shallow freshwater lake and marshes, 13 km inland from the coast near the El Salvador border.
Principal vegetation: No information.
Land tenure: Privately owned.
Protection: None.
Land use: Extensive cattle ranching in the area.
Waterfowl: No information.
Other fauna: No information.
Threats: No information.
Source: Luis M. Villar Anleu and Juan Carlos Godoy.
Criteria for inclusion: 0.

Laguna de Guija (6)

Location: 14°16'N, 88°33'W; 35 km east of Jutiapa, on the El Salvador border, Jutiapa Department.
Area: Total area of lake 4,300 ha; 1,380 ha in Guatemala.
Altitude: 427m.
Province and type: 8.16.4; 12.
Site description: A large permanent freshwater lake with fringing marshes, spanning the Guatemala / El Salvador border. (See El Salvador site 1)
Principal vegetation: No information.
Land tenure: Mainly private.
Protection: None.
Land use: Cattle ranching and agriculture in the area.
Waterfowl: No detailed information available, but known to be an important area for migratory Anatidae.
Other fauna: The fish fauna includes endemic species of Poecilidae, particularly of the genus *Heterandria*.
Threats: No information.
Source: Luis M. Villar Anleu and Juan Carlos Godoy.
Criteria for inclusion: 2b.

Laguna de Ayarza (7)

Location: 14°25'N, 90°07'W; 45 km ESE of Guatemala City, Santa Rosa Department.
Area: 1,400 ha.
Altitude: 1,407m.
Province and type: 1.21.12 (Nearctic); 14.
Site description: A permanent brackish lake of volcanic origin, up to 230m deep and with a narrow fringe of emergent aquatic vegetation (less than 100m wide). There are slight annual fluctuations in water level, and there has been a 2m variation in water level over a period of eight years.
Principal vegetation: Fringing marshes of *Scirpus* sp. In a region of thorn woodland.
Land tenure: The land surrounding the lake is privately owned.
Protection: None.
Land use: Fishing; recreation, including swimming and boating, particularly at weekends. Cultivation of maize, beans and sugar cane in surrounding areas.
Waterfowl: The lake has a resident population of *Podilymbus podiceps* and *Fulica americana*, and *Cairina moschata* may occur. One of the most important sites in Guatemala for migratory Anatidae, with *Dendrocygna bicolor, D. autumnalis* and *Anas discors* predominating.
Other fauna: No information.
Threats: Excessive disturbance from recreation activities, particularly at weekends.
Source: Ruben Velasquez.
Criteria for inclusion: 3a.

Laguna El Pino (8)

Location: 14°20'N, 90°23'W; 30 km SSE of Guatemala City, Santa Rosa Department.
Area: 72 ha.
Altitude: 1,022m.
Province and type: 1.21.12 (Nearctic); 12.
Site description: A permanent almost freshwater lake, up to 18m deep, with extensive fringing marshes; fed by several small streams. There are slight annual fluctuations in water level, and the level has varied by 1.6m over a 16 year period.
Principal vegetation: Submergent beds of *Elodea canadensis*; floating beds of *Eichhornia crassipes*; and marshes with *Eleocharis elegans* and *Scirpus californicus.* Surrounding areas with *Casuarina* sp, *Cupressus lusitanica, Inga xalapensis* and *Pinus* spp.
Land tenure: 20% of the shoreline is state owned; the remainder is private.
Protection: The lake was declared a National Park, but is managed as a recreation area.
Land use: Subsistence fishing, collection of snails, sport fishing, and recreation, including swimming and camping. There are coffee plantations in surrounding areas.
Waterfowl: Common breeding species include *Podilymbus podiceps, Bubulcus ibis, Gallinula chloropus, Fulica americana* and *Jacana spinosa. Dendrocygna bicolor* may breed.
Other fauna: No information.
Threats: Urban development, intensive recreation, and accelerated eutrophication caused by the inflow of organic waste.
References: Valenzuela (1982).
Source: Ruben Velasquez.
Criteria for inclusion: 3a.

Lago de Amatitlan (9)

Location: 14°28'N, 90°35'W; 15 km south of Guatemala City, Guatemala Department.
Area: 1,525 ha.
Altitude: 1,187m.
Province and type: 1.21.12 (Nearctic); 12.
Site description: A permanent freshwater lake, up to 33m deep, subject to fluctuations in water level of about 1.4m.

Principal vegetation: Beds of *Elodea canadensis* and *Ceratophyllum demesum.*
Land tenure: A mixture of municipal and private ownership.
Protection: No legal protection at present.
Land use: Recreation; production of hydroelectric and thermoelectric energy. The lake is a very popular weekend resort for the inhabitants of Guatemala City.
Waterfowl: Very few waterfowl; *Fulica americana* and Charadriidae occur seasonally.
Other fauna: No information.
Threats: The lake is under pressure from a variety of sources including: pollution from pesticides, hydrocarbons, domestic sewage and fertilizers; increased sedimentation as a result of erosion in surrounding watersheds; the construction of a causeway dividing the lake into two sections; and the construction of a marina and 900 weekend homes near the lake shore.
Research and conservation: The lake has been well studied and well documented. A National Commission for the Improvement and Restoration of Lago de Amatitlan has been created, and this includes representatives of government institutions, non-governmental bodies and the local municipalities. A project for the restoration, conservation, protection and improvement of the lake has been drawn up, but this has not as yet been approved.
References: Weiss *et al* (?); Calzada (1974); Silva (1975); Vasquez (1975); Tabarini de Abreu (1981); Instituto Nacional de Electrificacion (undated).
Source: Ruben Velasquez.
Criteria for inclusion: 3a.

Lago de Atitlan (10)

Location: 14°42'N, 91°12'W; at Santiago Atitlan, 65 km west of Guatemala City, Solola Department.
Area: 12,650 ha.
Altitude: 1,562m.
Province and type: 1.21.12 (Nearctic); 12.
Site description: A large permanent freshwater lake, up to 324m deep, surrounded by mountains and with three volcanic peaks rising to 3,550m on the south side. The lake is fed by a number of small streams; it has no surface outflow, water being lost through evaporation and seepage. The lake is oligotrophic; there are extensive fringing marshes in some areas, particularly along the south shore and in the Bahia de Santiago. Annual fluctuations in water level amount to about 1m, the level reaching its lowest at the end of the dry season (November to May). The level also fluctuates by up to 22m on a 40 year cycle; the lake is currently in the low phase of this long-term cycle. The level dropped by seven metres during an earthquake in 1976, and as a result, much of the marsh vegetation disappeared.
Principal vegetation: Submergent and floating beds of *Chara* sp, *Nitella* sp, *Potamogeton fragillimus, P. pectinatus, Eichhornia crassipes, Azolla filiculoides, Najas guadalupensis, Lemna valdiviana* and *Callitriche* sp; marshes with *Scirpus californicus, Typha domingensis* and *Cyperus odoratus.*
Land tenure: Mainly privately owned, with some parts owned by the state and local municipalities.
Protection: The lake itself was declared a National Park in 1955, but the shores remain unprotected and the park has never been properly administered or managed. All hunting of waterfowl has been prohibited since 1959, and a World Wildlife Fund Sanctuary of 2 ha was established in 1968 near Santiago Atitlan to protect several pairs of the endemic grebe.
Land use: Fishing, reed-cutting for handicrafts (baskets, carpets, furniture, etc.), and recreation. The bass *Micropterus salmoides* and *M. dolomieui* were introduced into the lake in 1958 and 1960 by a Tourist Commission, in an attempt to promote sport fishing. About 50,000 people live in the watershed of 548 kmÑ, and land surrounding the lake is intensively cultivated for maize, beans and coffee.
Waterfowl: The lake is best known for its endemic flightless grebe, the Atitlan Grebe *Podilymbus gigas.* No accurate censuses were made of the population until 1960. However, it is thought that there were about 400 birds at the turn of the century, and perhaps 100 breeding pairs in 1929. There were 200 birds in 1960, 80 in 1964, 135 in 1969 and 240 in 1975. Since then the population has declined rapidly; there were only 55 in May 1983, and

probably no more than 45 in late 1984. Other breeding species include *Ixobrychus exilis, Butorides virescens, Egretta alba, Gallinula chloropus, Jacana spinosa* and *Himantopus himantopus*. A variety of other waterfowl occur on migration and in winter, including large numbers of *Anas americana, Aythya affinis* and *Fulica americana*, and smaller numbers of *Ardea herodias, Anas clypeata, Oxyura jamaicensis, Porzana carolina, Actitis macularia, Gallinago gallinago* and *Larus atricilla*.

Other fauna: The lake supports a normal zooplankton fauna, but there are very few reptiles and amphibians, and it is doubtful if there were any native limnetic fishes. However, many species of fishes have been introduced, including the bass *Micropterus salmoides* and *M. dolomieui*, and the tilapia *Tilapia mossambica*.

Threats: The principal threats to the lake and its marshes include: the construction of holiday homes, hotels and recreation facilities along the shoreline; contamination with domestic sewage; increased siltation as a result of soil erosion on the surrounding hills; and general disturbance from human activities. There is still some illegal hunting of waterfowl, and reed-cutting, although prohibited for a part of the year, is permitted during the grebe breeding season (April and May). The natural fall in lake level has resulted in a loss of nesting habitat for the grebe, and the introduced bass may be a serious predator on grebe chicks.

Research and conservation: A considerable amount of research has been conducted on the endemic grebe, particularly by LaBastille between 1960 and 1973, and by Velasquez in recent years. Other studies have focussed on the potential of the lake for tourism, its limnology, and the introduced fishery. In early 1984, CECON and INAFOR, with the assistance of the U.S. Fish and Wildlife Service, initiated a captive breeding programme for *P. gigas*. It seems very unlikely that the grebe will survive in the wild for many more years, unless immediate steps are taken to improve the integrity of the National Park, and an appropriate management plan is implemented.

References: Clark (1908); Meek (1908); Atwood (1933); Carnet & Donville (1957); Williams (1960); Bowes & Bowes (1962); Cazali & Prado (1963); Crowe (1967); Dorris & Summerfelt (1967); Instituto Nacional de Electrificacion (1967); Powers & Bowes (1967); Instituto Geografico Nacional (1969 & 1970); Weiss (1971); LaBastille (1972, 1974 & 1983); IUCN (1982).

Source: Ruben Velasquez.

Criteria for inclusion: 123.

Laguna de Yolnabaj (11)

Location: 16°03'N, 91°34'W; on the Mexican border, 80 km north of Huehuetenango, Huehuetenango Department.

Area: 385 ha.

Altitude: 1,142m.

Province and type: 1.21.12 (Nearctic); 12.

Site description: A permanent shallow freshwater lake and marshes in the northern foothills of the Sierra de los Cuchumatanes.

Principal vegetation: No information.

Land tenure: A mixture of private and municipal ownership.

Protection: None.

Land use: Hunting and fishing; wood-cutting and the cultivation of maize in surrounding areas.

Waterfowl: No information.

Other fauna: No information.

Threats: None known.

Source: Luis M. Villar Anleu and Juan Carlos Godoy.

Criteria for inclusion: 0.

Bujajal-Polochic Marshes (12)

Location: 15°23'N, 89°30'W; west of Lago de Izabal, Izabal Department.
Area: 18,500 ha.
Altitude: 2.5-4m.
Province and type: 8.16.4; 09, 11, 13 & 16.
Site description: The extensive largely seasonal marshes and floodplain of the Rio Polochic, with some small permanent fresh and brackish lakes; at the west end of Lago de Izabal.
Principal vegetation: Lakes and marshes with *Chara vulgaris*, *Ceratopteris pteridoïdes*, *Acrostichum daneaefolium*, *Azolla caroliniana*, *Salvinia auriculata*, *Nymphaea ampla*, *Utricularia foliosa*, *Jussiaea natans*, *Hymenocallis littoralis*, *Pistia stratiotes*, *Vallisneria americana*, *Pontederia sagittata* and *Typha domingensis*; riverine forest with *Pachira aquatica*, *Lonchocarpus guatemalensis*, *Cecropia mexicana*, *Acacia hindsii* and *Bucida buceras*.
Land tenure: Privately owned.
Protection: None.
Land use: Extensive cattle ranching, some rice growing, and hunting.
Waterfowl: An important area for Ardeidae.
Other fauna: A few *Crocodylus moreletii* and possibly *Tapirus bairdii* occur. *Trichechus manatus* may reach this area from Lago de Izabal.
Threats: None known.
Research and conservation: The vegetation of the region has been described by Poll.
References: Poll (1983).
Source: Luis M. Villar Anleu and Juan Carlos Godoy.
Criteria for inclusion: 3a.

Lago de Izabal (13)

Location: 15°30'N, 89°10'W; near the Caribbean coast of eastern Guatemala, Department of Guatemala.
Area: 58,960 ha.
Altitude: 1m.
Province and type: 8.16.4; 09, 12, 16, 17 & 18.
Site description: The largest lake in Guatemala; permanent, slightly brackish, up to 16m deep, and with fringing marshes along about 60% of the shoreline and some swamp forest. The water level fluctuates seasonally by about 0.9m. The lake is often influenced by strong winds from the northeast, particularly in the afternoons.
Principal vegetation: Marshes with species of *Chara*, *Potamogeton*, *Scirpus* and *Typha*; and swamp forest. In a zone of humid tropical forest, but most of the forests have been cleared for pastureland.
Land tenure: 30% privately owned in farms, and the remainder in municipal ownership.
Protection: No effective protection, although a part of the lake was included in the Rio Dulce National Park (24,200 ha) established in 1956.
Land use: Traditional fishing, transportation and recreation.
Waterfowl: An important wetland for a wide variety of resident and migratory waterfowl. Resident species include *Podilymbus podiceps*, *Anhinga anhinga*, *Tigrisoma mexicanum*, *Nyctanassa violacea*, *Cochlearius cochlearius*, *Butorides virescens*, *Egretta tricolor*, *E. thula*, *E. alba*, *Mycteria americana*, *Jabiru mycteria*, *Ajaia ajaja*, *Cairina moschata*, *Aramus guarauna*, *Aramides cajanea*, *Laterallus ruber*, *Porphyrula martinica*, *Fulica americana*, *Heliornis fulica*, *Eurypyga helias*, *Jacana spinosa* and *Himantopus himantopus*. Common passage migrants and winter visitors include *Charadrius vociferus*, *Tringa solitaria*, *Actitis macularia*, *Larus atricilla* and *Chlidonias nigra*.
Other fauna: The Osprey *Pandion haliaetus* is a fairly common migrant. The manatee *Trichechus manatus* and Morelet's Crocodile *Crocodylus moreletii* occur, but both are very rare. The fish *Cichlasoma maculicauda* is abundant and of great importance in the local economy.
Threats: There is a serious pollution problem from pesticides used in intensive agricultural developments on adjacent land, and there is a potential threat from the possible revival of nickel mining activities in the area.

Research and conservation: Only preliminary investigations of the fauna and flora have been carried out, and further work is urgenty required in view of the serious problem from pollution.
References: Brinson & Nordie (1975); IUCN (1982).
Source: Luis M. Villar Anleu.
Criteria for inclusion: 2b & 3a.

Golfete and the Rio Dulce and Rio Chocon (14)

Location: 15°45'N, 88°50'W; between Lago de Izabal and Bahia de Amatique on the Caribbean coast, Izabal Department.
Area: c.10,000 ha.
Altitude: 0–10m.
Province and type: 8.16.4; 07, 08, 09, 16, 17 & 18.
Site description: A very slow-flowing river between Lago de Izabal and the Caribbean, with a wide lake-like section (Golfete) 16 km long by 7 km at its widest, and up to 13m deep. The water level fluctuates seasonally by about 0.9m. There are mangrove swamps near the coast; swamp forests inland; and extensive marshes, wet meadows and seasonally flooded plains, particularly along the lower Rio Chocon. Winter flooding creates one large lake. In summer, as the water level falls, sea water intrudes into the Rio Dulce, and the water becomes brackish up to Lago de Izabal. Some of the best wetland habitat is in the delta marshes of the Rio Chocon, on the north shore of Golfete.
Principal vegetation: Mangrove swamps dominated by *Rhizophora mangle* and *Pachira aquatica*; lakes and marshes with species of *Typha, Scirpus, Ceratophyllum, Vallisneria* and *Cabomba*; and swamp forest with *Pithecolobium belizense, Pterocarpus officinalis, Spondias mombin, Terminalia amazonia* and the palm *Desmoncus ferox.* In a region of humid tropical forest, although most of the original forest has now been cleared.
Land tenure: State owned.
Protection: A strip one km wide along the shore of the river is included in the Rio Dulce National Park. The northern portion of Golfete, the delta of the Rio Chocon and adjacent land are included in the "Biotopo Chocon-Machacas" reserve (7,600 ha), established for the conservation of the manatee and managed by CECON with the assistance of INGUAT. The southern shore of Golfete is unprotected.
Land use: Traditional fishing, transportation and recreation.
Waterfowl: An important area for a wide variety of waterfowl including several which are rare elsewhere in Guatemala. Residents include *Podilymbus podiceps, Pelecanus cccidentalis, Anhinga anhinga, Tigrisoma mexicanum, Nyctanassa violacea, Cochlearius cochlearius, Butorides virescens, Egretta thula, E. alba, Mycteria americana, Jabiru mycteria, Ajaia ajaja, Cairina moschata, Aramus guarauna, Aramides cajanea, Laterallus ruber, Porphyrula martinica, Fulica americana, Heliornis fulica, Eurypyga helias, Jacana spinosa* and *Himantopus himantopus.* A number of Nearctic shorebirds and Laridae have been recorded on migration and in winter, the commoner species including *Charadrius vociferus, Tringa solitaria* and *Actitis macularia.*
Other fauna: The Osprey *Pandion haliaetus* is a common non-breeding visitor. The Central American Otter *Lutra anectens*, Baird's Tapir *Tapirus bairdii* and the manatee *Trichechus manatus* occur in small numbers, and the area supports a rich fish fauna.
Threats: A project for intensive agricultural development in the region threatens to alter much of the wetland habitat. There is some pollution from domestic sewage, and some illegal hunting. Surrounding areas are rapidly being deforested.
Research and conservation: The region is of considerable geological interest in that it lies on the Polochic Fault which cuts across Guatemala from east to west, and delimits the North American and Caribbean tectonic plates. Some preliminary studies have been conducted on the fauna and flora, and a master plan has been prepared for the Biotopo Chocon-Machacas. The area under management includes five small lakes with an average size of 20 ha, and seven small tributaries.
References: USAC & INGUAT (1981); IUCN (1982).
Source: Luis M. Villar Anleu.
Criteria for inclusion: 2a, 2b & 3a.

La Graciosa marshes (15)

Location: 15°50'N, 88°33'W; north of Puerto Barrios, Izabal Department.
Area: 6,000 ha of marshes.
Altitude: 0-0.5m.
Province and type: 8.16.4; 01, 03, 05, 07 & 08.
Site description: A brackish inlet with brackish marshes, mangrove swamps and coastal sand dunes, on the eastern shore of Bahia de Amatique, a shallow sea bay 40 km long by 18 km wide. The tidal rise and fall is about 90 cm.
Principal vegetation: Mangrove swamps. In a region of humid tropical forest, with vegetation similar to site 14.
Land tenure: State owned.
Protection: No habitat protection.
Land use: Fishing, transportation and recreation.
Waterfowl: An important area for waterfowl, with almost the same species as Golfete and the Rio Dulce (site 14). The area is particularly important for *Pelecanus occidentalis*, *Phalacrocorax olivaceus* and migratory Laridae, e.g. *Larus atricilla* and *Sterna maxima.*
Other fauna: The Osprey *Pandion haliaetus* is a common non-breeding visitor, and the manatee *Trichechus manatus* is known to occur.
Threats: None known.
Research and conservation: Some preliminary avifaunal surveys have been conducted in the area. There are plans for the establishment of a reserve (Biotopo Protegido) at Punta de Manabique, at the northern edge of the bay.
Source: Luis M. Villar Anleu.
Criteria for inclusion: 2a & 3a.

Laguna de Lachua (16)

Location: 15°55'N, 90°40'W; 85 km west of El Achiotal, Alta Verapaz Department.
Area: 5,600 ha.
Altitude: 173m.
Province and type: 8.1.1; 12 & 18.
Site description: A permanent shallow freshwater lake and marshes surrounded by seasonally inundated forest, in the valley of the Rio Chixoy near the Mexican border.
Principal vegetation: Marshes and swamp forest with *Cabomba aquatica, Acrostichum* sp, *Cyperus* sp, *Eleocharis* sp, *Andropogon* sp, *Phragmites* sp, *Lonchocarpus guatemalensis, Pachira aquatica, Chrisobalanus icaco, Bucida burceras, Achras zapota* and *Sabal morrisiana.*
Land tenure: State owned.
Protection: None at present.
Land use: Occasional hunting and fishing; the area has not been developed and remains relatively undisturbed.
Waterfowl: Species known or thought to breed include *Podiceps dominicus, Aramus guarauna, Aramides cajanea, Porphyrula martinica* and *Gallinula chloropus. Anas americana* and *Aythya affinis* have been recorded on migration.
Other fauna: Five species of kingfisher Alcedinidae occur around the lake.
Threats: Agricultural development in the immediate vicinity.
Research and conservation: Preliminary botanical and avifaunal surveys have been carried out, and it has been suggested that a National Park or Biotope Reserve be established at the lake.
References: Ponciano (1982a & 1982b).
Source: Juan Carlos Godoy and Ruben Velasquez.
Criteria for inclusion: 3a.

Petexbatun and Las Pozas Lakes (17)

Location: 16°27'N, 90°14'W; west and south of Sayaxche, Peten Department.
Area: 5,050 ha.
Altitude: 110m.
Province and type: 8.1.1; 09, 12 & 16.
Site description: A complex of permanent shallow freshwater lakes and marshes, with surrounding areas of seasonally flooded marshes and grassland.
Principal vegetation: Lakes with submergent beds of *Potamogeton, Chara* and *Nitella*; marshes with species of *Cyperus, Eleocharis* and *Acrostichum*; and flood zone with species of *Spilanthes, Panicum, Scleria, Rynchospora* and *Heliconia.* In a region of humid tropical forest.
Land tenure: A mixture of private and municipal ownership.
Protection: No habitat protection, although archeological sites in the area are protected.
Land use: Wood-cutting and cultivation of maize and beans in surrounding areas; some tourism at the archeological sites.
Waterfowl: Similar to Lago Peten-Itza (site 19).
Other fauna: The fish fauna includes the scarce *Lepisosteus tropicus* and economically important species such as *Petenia splendida* and species of *Cichlasoma.*
Threats: None known.
References: Aguilar (1974).
Source: Luis M. Villar Anleu and Juan Carlos Godoy.
Criteria for inclusion: 3a.

Yaxja and Sachab Lakes (18)

Location: 17°03'N, 89°25'W; 30 km ESE of Tikal, Peten Department.
Area: 1,925 ha.
Altitude: 158m.
Province and type: 8.1.1; 12 & 16.
Site description: A group of permanent, fairly shallow freshwater lakes with surrounding marshes, and seasonally flooded plains to the north.
Principal vegetetation: Aquatic vegetation including species of *Cabomba, Naias, Nitella, Chara, Typha, Eleocharis, Pistia, Cyperus* and *Cladium*, with some *Vigna repens, Cassytha filiformis, Pithecolobium platylobum, Cucurbita radicans* and *Asclepias curassavica.* In a region of humid tropical forest.
Land tenure: A mixture of private and municipal ownership.
Protection: None.
Land use: Fishing and recreation; wood-cutting nearby, and extensive agriculture to the south.
Waterfowl: Similar to Peten-Itza (site 19).
Other fauna: The rich fish fauna includes a variety of Cichlidae and Poecilidae.
Threats: None known.
Source: Luis M. Villar Anleu and Juan Carlos Godoy.
Criteria for inclusion: 3a.

Lago Peten-Itza and Petenchel (19)

Location: 16°59'N, 89°50'W; 30 km southwest of Tikal, Peten Department.
Area: 10,370 ha.
Altitude: 112m.
Province and type: 8.1.1; 12 & 18.
Site description: A group of permanent freshwater lakes with fringing marshes and swamp forest; fed by several small streams and with no surface outflow. Lago Peten-Itza (30 km long by up to 5 km wide, and up to 45m deep) is much the largest of the group, and the largest lake in this region of Guatemala. The lake level fluctuates seasonally by about 38 cm, but there are also long-term fluctuations of about 8m over a 50-60 year cycle. Soils in the region are calcareous.

Principal vegetation: Lakes with beds of *Elodea* sp and *Ceratophyllum sp;* marshes with species of *Typha* and *Scirpus*; and swamp forest. In a region of humid tropical forest.
Land tenure: Municipal ownership.
Protection: A five km stretch of the northeast shore of Lago Peten-Itza is included in the Biotopo Cerro Cahui reserve, managed by CECON with the assistance of INGUAT; the remainder of the area is unprotected.
Land use: Traditional fishing, some hunting of turtles, transportation, and a little recreation. The area is relatively undisturbed.
Waterfowl: Little information is available on the waterfowl of this area and other similar wetlands in northern Guatemala (sites 17 to 24). Species known or thought to be resident include *Podilymbus podiceps, Phalacrocorax olivaceus, Tigrisoma mexicanum, Nycticorax nycticorax, Nyctanassa violacea, Cochlearius cochlearius, Butorides virescens, Egretta caerulea, E. tricolor, E. thula, E. alba, Agamia agami, Mycteria americana, Jabiru mycteria, Cairina moschata, Aramus guarauna, Aramides cajanea, Laterallus ruber, Porphyrula martinica, Fulica americana, Heliornis fulica, Eurypyga helias, Jacana spinosa, Charadrius collaris* and *Himantopus himantopus.* Passage migrants and winter visitors include *Ardea herodias, Dendrocygna autumnalis, Charadrius vociferus, Tringa solitaria, Actitis macularia* and *Larus atricilla.*
Other fauna: Birds of prey include *Pandion haliaetus, Rostrhamus sociabilis, Buteogallus anthracinus* and *Busarellus nigricollis.*
Threats: None known.
Research and conservation: Some preliminary botanical and avifaunal studies have been conducted, but further work is required.
References: USAC & INGUAT (1980).
Source: Luis M. Villar Anleu.
Criteria for inclusion: 3a.

Laguna Perdida (20)

Location: 17°04'N, 90°13'W; 65 km WSW of Tikal, Peten Department.
Area: 1,825 ha.
Altitude: 68m.
Province and type: 8.1.1; 12.
Site description: A permanent freshwater lake and surrounding marshes on calcareous soils; fed by several small streams and with no surface outflow.
Principal vegetation: The dominant species include *Eleocharis intersticta, Phragmites communis, Nymphaea ampla, Spilanthes americana, Viguiera dentata, Passiflora foetida, Cucurbita radicans, Cereus undatus* and *Pachira aquatica.*
Land tenure: A mixture of private and municipal ownership.
Protection: None.
Land use: Wood-cutting and some intensive agriculture in surrounding areas.
Waterfowl: Similar to Lago Peten-Itza (site 19).
Other fauna: No information.
Threats: None known.
Source: Luis M. Villar Anleu and Juan Carlos Godoy.
Criteria for inclusion: 3a.

Los Medanos lakes and marshes (21)

Location: 17°16'N, 90°29'W; 90 km west of Tikal, Peten Department.
Area: 9,600 ha.
Altitude: 67m.
Province and type: 8.1.1; 09, 11, 12 & 18.
Site description: A complex of small permanent freshwater lakes, marshes and swamp forest near the Rio San Pedro, and the riverine marshes along that river; in a low-lying karst region.

Principal vegetation: The dominant species include *Rynchospora aristata, Scleria hirella, Wedelia parviceps, Cyperus luzulae* and species of *Trachypogon, Andropogon, Paspalum, Axonopus* and *Leptocorypium.*
Land tenure: A mixture of state and municipal ownership.
Protection: None.
Land use: Some wood-cutting and agriculture in surrounding areas; there is an archeological site (El Peru) nearby.
Waterfowl: Similar to Lago Peten-Itza (site 19).
Other fauna: No information.
Threats: None known.
References: Lundell (1937); Godoy (1984).
Source: Juan Carlos Godoy.
Criteria for inclusion: 3a.

Rio Escondido and marshes (22)

Location: 17°17'N, 90°51'W; west of El Naranjo, near the Mexican border, Peten Department.
Area: 17,900 ha.
Altitude: 45m.
Province and type: 8.1.1; 10, 11, 13 & 18.
Site description: A fast-flowing river and extensive shallow freshwater marshes and swamp forest, with some small freshwater lakes.
Principal vegetation: Swamp forests with *Conostegia xalapensis, Erytroxylon areolatum, Eugenia capuli, Mimosa albida, Simaruba glauca, Acrocomia mexicana, Curatella americana, Acacia spadicigera* and species of *Brosimum, Bucida, Casia, Enterolobium, Licania, Guarea, Pouteria, Luehea, Spondias* and *Cochlospermum.* In a region of humid tropical forest.
Land tenure: Unknown.
Protection: None.
Land use: Hunting, fishing, wood-cutting, and capture of animals for the zoo and pet trade, for sale in Guatemala and for exportation.
Waterfowl: Similar to Lago Peten-Itza (site 19).
Other fauna: *Crocodylus moreletii* occurs.
Threats: None known.
References: Godoy (1984).
Source: Juan Carlos Godoy.
Criteria for inclusion: 3a.

El Tigre lakes (23)

Location: 17°37'N, 90°56'W; 40 km north of El Naranjo, in extreme northwestern Guatemala near the Mexican border, Peten Department.
Area: 16,700 ha.
Altitude: 50m.
Province and type: 8.1.1; 12, 16 & 18.
Site description: A group of small permanent freshwater lakes and marshes with surrounding irregularly flooded grassland and swamp forest; in a low-lying karst region.
Principal vegetation: Marshes and swamp forest with *Eleocharis retroflexa, Fuirena simplex, Pachira aquatica, Haematoxylum campechianum, Talisia floresii, Diospyros bumelioides, Cupania belizense, Achras zapota, Cestrum panamensis*, and species of *Croton, Phyllanthus, Caesalpinia, Cryosophila, Sabal* and *Swietenia.*
Land tenure: Within state and private concessions for the exploitation of timber and oil resources.
Protection: None.
Land use: Very little at present; some hunting of large mammals, and some exploitation of *Achras zapota* (the chewing-gum tree).
Waterfowl: Similar to Lago Peten-Itza (site 19).

Other fauna: *Crocodylus moreletii* occurs.
Threats: Development of the petroleum industry.
References: Lundell (1937).
Source: Juan Carlos Godoy.
Criteria for inclusion: 0.

Rio Candelaria and marshes (24)

Location: 17°45'N, 90°42'W; 60 km NNE of El Naranjo, on the Mexican border, Peten Department.
Area: 17,500 ha.
Altitude: 60m.
Province and type: 8.1.1; 10, 11, 13, 16 & 18.
Site description: A complex of small permanent shallow freshwater lakes, marshes, seasonally flooded grassland and swamp forest.
Principal vegetation: Natural grassland subject to seasonal flooding; in a region of humid tropical forest with trees less than 6m high.
Land tenure: State owned.
Protection: None.
Land use: Very little; some cattle ranching nearby, and some illegal capture of wildlife for exportation by Mexican poachers.
Waterfowl: Similar to Lago Peten-Itza (site 19).
Other fauna: *Crocodylus moreletii* occurs.
Threats: Development of the petroleum industry.
References: Lundell (1937); Godoy (1984).
Source: Luis M. Villar Anleu and Juan Carlos Godoy.
Criteria for inclusion: 0.

HONDURAS

INTRODUCTION

based on information provided by Wilberto Aguilar and Mercedes Sierra Reyes, and information taken from Campanella *et al* (1982)

Honduras, the second largest country in Central America, is also that with the greatest geological and biological diversity. The total area is 112,088km^2, and the population, according to 1980 estimates, some 3,691,000.

The topography is very mountainous, and more than 75% of Honduran territory has gradients greater than 25%. Three main regions can be distinguished: the highlands and inner valleys, the Caribbean lowlands, and the Pacific lowlands. The highlands and inner valleys, comprising 81.7% of the country, consist of mountain ranges with peaks up to 2,849m and intermontane basins at 990-1,400m; the poor soils are stony and acidic. The Caribbean lowlands, comprising 16.4% of the country, are narrow alluvial floodplains stretching for 640 km along the Caribbean coast and extending in valleys into the interior. The Pacific lowlands, comprising 1.9% of the country, include 124 km of mangrove coast around the Golfo de Fonseca, and the narrow floodplains of several rivers such as the Rio Choluteca.

The climate of the Caribbean lowlands is dominated by the east and southeast trade winds which change direction in winter as cold currents move along the coast, giving rise to winds from the north and west and some rain. The main rainy season is from the middle of April to October, the region receiving more than 2,400 mm of rain annually. In the interior highlands, the annual rainfall is less than 1,000 mm, while in the Pacific lowlands, the annual rainfall varies from 400-2,000 mm, depending on local topography. Temperatures throughout the country are generally determined by altitude. Although the southwest Caribbean is not noted for having a high incidence of hurricanes, the north coast of Honduras and the Islas de la Bahia have been struck by thirteen hurricanes and eight tropical storms during the present century.

The classification of Monroe (1968) recognizes eight major natural habitats in Honduras, as follows:

a) Lowland tropical rain forest, limited to the Caribbean drainage at elevations up to 750m, and consisting of broadleaf evergreen forests with some deciduous species.
b) Tropical deciduous forest (monzon), replacing rain forest when marked seasonality in the rainfall constitutes the predominant climatic pattern. This forest is the dominant vegetation in the Pacific lowlands, but because of modification of the habitat for cultivation and grazing, it is now restricted to a few scattered enclaves along rivers and streams.
c) Cloud forest, consisting of humid broadleaf forests in the highlands, at elevations between 1,350 and 2,300m in the south, and between 900 and 2,800m in the Caribbean basin.
d) Dry thorny shrubland, occurring in the south and in some zones in the centre of the country.
e) Mixed pine and oak forests in the highlands of western Honduras, at elevations between 600 and 1,800m. The dominant species are *Quercus* sp, *Pinus oocarpa* and *P. pseudostrobus.*
f) Lowland pine savanna, dominated by the Caribbean Pine *Pinus caribea*, with some tracts of gallery forest along the main rivers.
g) Mangrove swamps, occurring widely on both coasts. On the Caribbean coast, the dominant mangrove species are *Rhizophora mangle* and *Laguncularia racemosa. Erythrina cristagalli* and *Pachira acuatica* appear behind the mangroves. On the Pacific coast, the dominant mangroves are *Rhizophora mangle, R. samoensis, Conocarpus erectus, Laguncularia racemosa, Avicennia bicolor* and *A. germinans.*
h) Coastal wetlands, including areas adjacent to the Bahia de Omoa, the Rio Ulua and the eastern lakes of the Caribbean coast, together with the wetlands around the Golfo de Fonseca on the Pacific coast.

Institutional Base for Wetland Conservation and Research

The principal organizations concerned with environmental conservation in Honduras are:

The Direccion General de Recursos Naturales Renovables (DIGERENARE), a governmental body created in 1974 to protect the nation's flora and fauna. The Departamento de Vida Silvestre y Recursos Ambientales in DIGERENARE conducts appropriate research.
The Asociacion Hondurena, a non-governmental conservation body.

Progress in wetland conservation and research

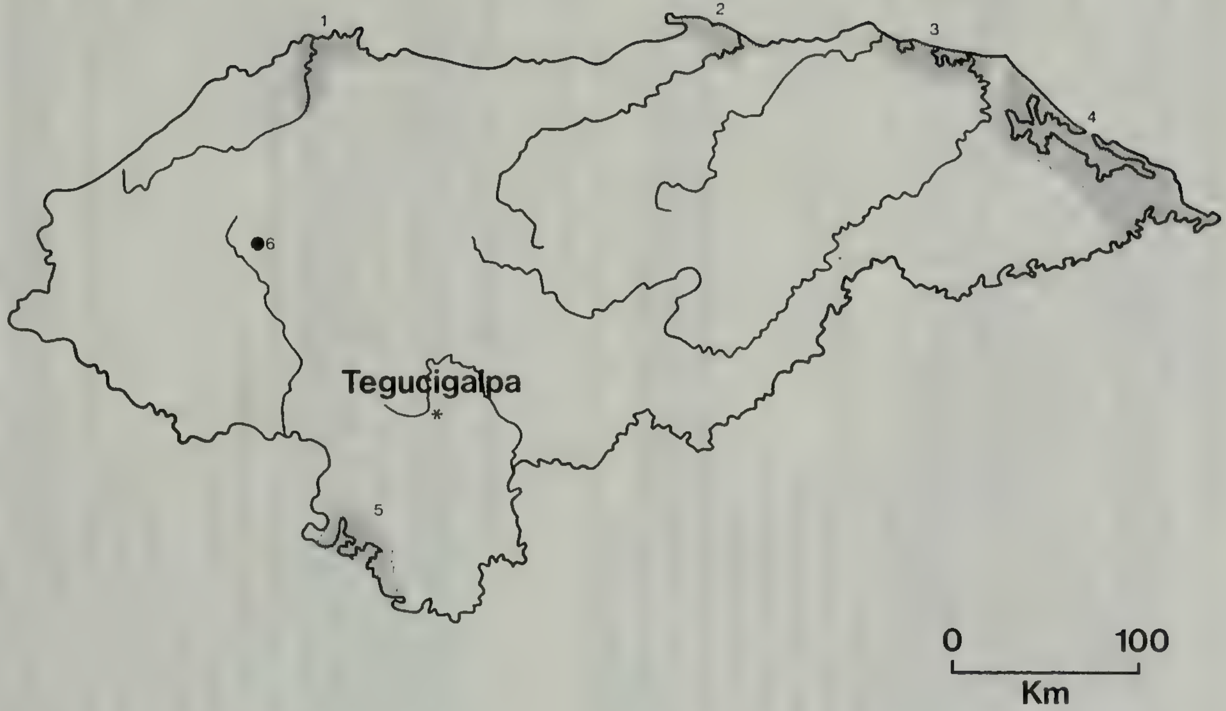
The Direccion General de Recursos Naturales Renovables has drawn up an inventory of potential areas for the development of a national system of protected areas (Sistema Nacional de Areas Silvestres). It is hoped that six management categories can be developed: National Parks, Biosphere Reserves, Natural Monuments, Biological Reserves, Wildlife Refuges and National Recreation Areas. Twenty-four areas have been listed in the preliminary selection. These include "La Tigra" (7,651 ha) as a National Park, "Rio Platano" as a Biosphere Reserve, "Cuevas de Talaube" as a Natural Monument, the "Montana de Celaque" as a Biological Reserve, and the "Refugio de Manati" between the Cuero and Salado Rivers as a Wildlife Refuge. However, it is also hoped that refuges will be created for cats, crocodiles and *Cunniculus paca.*

Recent research includes the following:
a) A study of the current status of the wildlife (including birds) of the Rio Platano Biosphere Reserve (M.J. Marcus, Departamento de Vida Silvestre y Recursos Ambientales, 1981)
b) An inventory of the birds of Honduras (Departamento de Vida Silvestre y Recursos Ambientales and Universidad Nacional Autonoma, 1980).
c) An inventory of the avifauna of the lakes of Cortes Department, initiated in 1983.

Major Threats to Wetlands

The principal threats to wetlands in Honduras are changes in the water regime resulting from extensive deforestation, and pollution caused by fishermen.

HONDURAS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WETLANDS

Site descriptions based on information provided by Wilberto Aguilar, Gustavo Adolfo Cruz and Mercedes Sierra Reyes of the Departamento de Vida Silvestre y Recursos Ambientales.

Laguna de Los Micos and the Rio Ulua Delta (1)

Location: 15°22'-15°55'N, 87°30'-87°55'W; in the Sula Valley, east and northeast of San Pedro de Sula, Departments of Cortes and Atlantida.
Area: c.55,000 ha.
Altitude: 0-25m.
Province and type: 8.16.4; 02, 07, 08, 09, 11 & 12.
Site description: The lower Rio Ulua from the region of La Lima to its delta, with riverine marshes and about a dozen small freshwater lakes; the extensive fresh to brackish marshes and mangrove swamps of the delta; and Laguna de Los Micos (5,400 ha) in the eastern delta.
Principal vegetation: No information.
Land tenure: No information.
Protection: None.
Land use: No information.
Waterfowl: No information.
Other fauna: No information.
Threats: No information.
Research and conservation: Some preliminary faunal and floral studies have been conducted in the area by the Departamento de Fauna Silvestre y Recursos Ambientales.
Source: Wilberto Aguilar and Mercedes Sierra Reyes.
Criteria for inclusion: 0.

Laguna de Guaymoreto and the Rio Aguan Delta (2)

Location: 15°45'-16°00'N, 85°30'-85°55'W; west of Bahia de Trujillo, Colon Department.
Area: c.34,000 ha.
Altitude: 0-5m.
Province and type: 8.16.4; 02, 05, 07, 08, 09 & 11.
Site description: A large brackish coastal lagoon (4,300 ha) and the estuarine and delta system of the Rio Aguan to the east; with fresh to brackish marshes and mangrove swamps.
Principal vegetation: Mangrove swamps.
Land tenure: No information.
Protection: None.
Land use: No information.
Waterfowl: No information.
Other fauna: The manatee *Trichechus manatus* is known to occur.
Threats: No information.
Research and conservation: The area is currently under study for the possible creation of a reserve for manatees.
Source: Wilberto Aguilar and Mercedes Sierra Reyes.
Criteria for inclusion: 2a & 3a.

Laguna de Ibans, Laguna de Brus and the Rio Platano (3)

Location: 15°35'-15°55'N, 84°20'-84°55'W; on the Caribbean coast between Rio Tinto and Rio Patuca, Department of Gracias a Dios.
Area: c.110,000 ha.
Altitude: 0-20m.
Province and type: 8.16.4; 02, 05, 07, 08, 09, 11 & 16.

Site description: Two large brackish coastal lagoons, Laguna de Ibans (6,600 ha) and Laguna de Brus (11,500 ha); the mangrove swamps and fresh to brackish marshes of the lower Rio Platano; and a complex of freshwater lakes, marshes and seasonally flooded grassland and pine savanna near the mouth of the Rio Patuca.
Principal vegetation: Mangrove swamps; swamp forest; seasonally flooded grassland; pine savannas with *Pinus caribea*; and gallery forest along the Rio Platano and main tributaries. In the humid tropical zone.
Land tenure: Largely state owned.
Protection: Partly included within the Rio Platano Biosphere Reserve (350,000 ha) established in 1980, and designated as a World Heritage Site in 1982.
Land use: Little disturbed; a remote area, with some small indigenous communities.
Waterfowl: Known to be a very rich area for waterfowl, but no details available.
Other fauna: Over 375 species of birds have been recorded in the Biosphere Reserve. The Central American Otter *Lutra anectens*, manatee *Trichechus manatus* and crocodilians *Crocodylus acutus* and *Caiman crocodilus fuscus* occur.
Threats: There is some illegal hunting, and a possible threat from the exploitation of forests in the area.
Research and conservation: Basic inventories of the natural and cultural resources have been conducted in the Biosphere Reserve. The area is of considerable archeological and anthropological interest.
References: DIGERENARE & CATIE (1980); Marcus (1981); IUCN (1982).
Source: Wilberto Aguilar and Mercedes Sierra Reyes.
Criteria for inclusion: 2a, 2b & 3a.

Laguna de Caratasca and nearby lagoons (4)

Location: 14°55'-15°55'N, 83°10'-84°15'W; on the Caribbean coast of eastern Honduras, near the Nicaraguan border, Department of Gracias a Dios.
Area: 370,000 ha.
Altitude: 0-10m.
Province and type: 8.16.4; 02, 05, 07, 08, 09, 11 & 16.
Site description: A vast complex of fresh to brackish coastal lagoons and marshes, mangrove swamps, and areas of seasonally flooded grassland, between the mouth of the Rio Patuca in the west and Rio Coco (Segovia) on the Nicaraguan border in the east. The principal lagoons are Laguitara (5,700 ha), Tibalakan (3,500 ha), Siska (1,700 ha), Warunta (12,500 ha), Caratasca (80,000 ha), Kohunta (7,000 ha) and the Apolka complex (2,200 ha). The lagoons and marshes are fed by a number of small rivers.
Principal vegetation: No information.
Land tenure: No information.
Protection: None.
Land use: No information.
Waterfowl: No information.
Other fauna: No information.
Threats: No information.
Research and conservation: The largest wetland complex in Honduras, and one of the remotest areas in the country. It remains very poorly known, and clearly merits proper investigation.
Source: Wilberto Aguilar and Mercedes Sierra Reyes.
Criteria for inclusion: 0.

Golfo de Fonseca (5)

Location: 13°00'-13°30'N, 87°15'-87°50'W; 90 km SSW of Tegucigalpa, on the El Salvador and Nicaraguan borders, Department of Valle Choluteca.
Area: 71,000 ha.
Altitude: 0-10m.
Province and type: 8.16.4; 02, 05, 06, 08 & 09.

Site description: An extensive system of estuaries with intertidal mudflats, mangrove swamps and sand beaches, on a large sea bay shared by Honduras, El Salvador and Nicaragua. (See El Salvador site 8, and Nicaragua site 1.)
Principal vegetation: Mangrove swamps with *Rhizophora mangle, Avicennia* sp, *Laguncularia racemosa* and *Conocarpus erectus*; *Hippomane mancinella* on drier sites.
Land tenure: Almost entirely state owned.
Protection: All the mangrove areas are included in the Golfo de Fonseca Forest Reserve (50,000 ha) established in 1958.
Land use: Fishing, exploitation of salt, and wood-cutting.
Waterfowl: No information, but presumably similar to Nicaragua site 1.
Other fauna: There are commercially important populations of clams, and the area is an important nursery ground for commercially important fishes and shrimps harvested in the Golfo de Fonseca. Large numbers of the sea turtle *Lepidochelys olivacea* nest on the beaches, and there are small populations of *Crocodylus acutus* and *Caiman crocodilus fuscus.*
Threats: The cutting of mangroves for fuel.
Research and conservation: Studies have been conducted on the sea turtles by DIGERENARE, and some work has been carried out on the mangrove resources.
References: IUCN (1982).
Source: See references.
Criteria for inclusion: 2c & 3a.

Lago de Yojoa (6)

Location: 14°55'N, 88°00'W; 70 km south of San Pedro Sula, Departments of Comayagua, Santa Barbara and Cortes.
Area: 9,000 ha.
Altitude: 635m.
Province and type: 1.21.12 (Nearctic); 12.
Site description: A large permanent freshwater lake and marshes in the mountains of western Honduras; the only large freshwater lake in the interior of the country. The maximum depth is 30m; the level fluctuates seasonally by about 3m and reaches its highest in winter and spring. A canal and several diversion dams have enlarged the catchment area of the lake.
Principal vegetation: The aquatic vegetation includes species of *Vallisneria, Potamogeton, Typha, Nymphaea, Cabomba, Eichhornia, Panicum, Cyperus, Scirpus* and *Nelumbo.* In a region of very humid subtropical forest.
Land tenure: A mixture of state and private ownership.
Protection: The lake is included within a Multiple Use Area (34,628 ha) established in 1971 to protect the watershed.
Land use: Commercial and sport fishing for introduced bass, tourism and recreation; cattle ranching and agriculture in surrounding areas. There is a considerable amount of human settlement around the lake.
Waterfowl: An important area for waterfowl. *Dendrocygna autumnalis* and *Cairina moschata* are resident, and *Anas discors* is a common non-breeding visitor. Both *Jacana spinosa* and *Jacana jacana* have been reported.
Other fauna: The introduced bass *Micropterus salmoides* supports sport and commercial fisheries.
Threats: The many threats to the lake include: pollution from domestic sewage and waste from nearby mines; contamination with fertilizers and pesticides from adjacent agricultural land; increased siltation as a result of deforestation of the watershed; and alteration of the shoreline for the construction of houses.
Research and conservation: DIGERENARE has conducted limnological studies, and G.A. Cruz is conducting research on the vegetation and on the population of *Micropterus salmoides.* A zoning plan detailing agricultural, touristic, urban and protected areas has been prepared for the Multiple Use Area, but this has not as yet been fully implemented.
References: Betancourt & Dulin (1978); Cruz (1979, in prep-a & in prep-b); IUCN (1982).
Source: Gustavo Adolfo Cruz.
Criteria for inclusion: 2b & 3a.

MEXICO

INTRODUCTION

based on information provided by Antonio Rogel Bahena, and information derived from Saunders & Saunders (1981)

Mexico has an area of 1,972,355 km^2, almost equally distributed on either side of the Tropic of Cancer, and a population of about 70,000,000. There are 6,760 km of coastline on the Pacific, and 2,900 km on the Gulf of Mexico. The country incorporates parts of two biogeographical realms, the Nearctic and the Neotropical, and thus possesses a great diversity in its fauna and flora.

The central region of Mexico consists of an immense plateau bordered by two great mountain systems, the Sierra Madre Oriental and the Sierra Madre Occidental, which almost parallel the coasts and have peaks rising to over 3,000m. The central plateau rises gradually from an elevation of approximately 900-1200m in the north to about 2,600m south of Mexico City. Almost the entire plateau is dry, and there are isolated mountains rising like islands to 3,000m. In the past, there were numerous natural lakes on the plateau, but for various reasons most of these have dried out. The two mountain systems end abruptly at the coastal plains, which vary greatly in width and are crossed by numerous rivers subject to seasonal flooding. Flooding is extensive in the delta regions which contain a series of lagoons of special importance for wintering populations of migratory waterfowl. The two cordilleras unite in the region of the Valle de Mexico, forming the Sierra Madre del Sur, which continues eastwards through a zone of low elevation (245m) and connects with the higher Sierra de Chiapas in the east. To the north and northeast of these sierras, the terrain descends to the plains of Tabasco, a vast delta region with extensive lakes and marshes, and the lowlands of Campeche, Yucatan and Quintana Roo on the Yucatan Peninsula. This peninsula is a calcareous plain, lacking mountains and rivers. The water courses are subterranean, coming to the surface near the coast and giving rise to a series of wetlands. The lagoons situated in the north of the peninsula are one of the most important areas for migratory waterfowl in Mexico.

On the central plateau, the climate is temperate, with wide variations in temperature between day and night. The rainfall shows considerable regional variation but in general, the winter is the dry season and the summer the wet. In the lowlands, below 750m, the climate is tropical, with high humidity and rainfall in the Gulf of Mexico and a much drier climate along the Pacific coast. Hurricanes along the Gulf Coast have on several occasions had a destructive effect on wetlands. In the Yucatan Peninsula the coastal lagoons have still not recovered from the effects of the hurricanes in the 1930s and 1940s, when large areas of mangroves were destroyed.

Institutional Base for Wetland Conservation and Research

There are many state or private organizations in Mexico dedicated to conservation and research, and a number of these include wetlands and/or waterfowl in their programme of activities. Some of the principal organizations are as follows:

Direccion General de Parques, Reservas y Areas Ecologicas Protegidas (Secretaria de Desarrollo Urbano y Ecologia); responsible for protected areas.

Direccion General de Flora and Fauna Silvestres (Secretaria de Desarrollo Urbano y Ecologia); conducts research including studies relating to the conservation of *Phoenicopterus ruber* and *Pandion haliaetus.*

Direccion de Flora y Fauna Acuaticas (Direccion General de Flora y Fauna Silvestres); a recently created body, responsible for the preparation of an inventory of aquatic flora and fauna.

Comision del Lago Texcoco (Secretaria de Agricultura y Recursos Hidraulicos); concerned with the investigation and conservation of Lago Texcoco.

Instituto Nacional en la Investigacion sobre Recursos Bioticos (INIREB); carries out ecological and ethological studies of turtles, crocodiles and other aquatic species.

Instituto de Biologia in the Universidad Nacional Autonoma de Mexico (UNAM); conducts ecological studies.
Instituto de Ecologica; dedicated to ecological research and the creation of reserves.
Instituto Nacional de Pesca; responsible for patrolling the breeding areas of sea turtles and conducting censuses of sea-lions and other marine species.
Instituto Tecnologico de Monterrey; conducts studies of marine mammals.
Facultad de Ciencias in UNAM; conducts ecological and taxonomic studies.
Universidad Michoacana de San Nicolas de Hidalgo; carries out studies relating to the conservation of sea turtles.
Universidad Autonoma de Baja California Sur; working on the ecology and conservation of marine mammals.
Universidad de Chiapas; conducts taxonomic studies.
Universidad de Veracruz; conducts ecological studies.
Universidad de Nuevo Leon, Monterrey; conducts studies on the fauna of Laguna Cuatro Cienagas.
Centro de Investigaciones de Quintana Roo (CIQRO); conducts research and carries out conservation programmes in Quintana Roo.
Bioconservacion y Pro Natura; carries out conservation work in cooperation with the Universidad Autonoma de Oaxaca.
Ducks Unlimited Mexico (DUMAC); carries out studies on migratory waterfowl, and is active in the conservation and restoration of wetlands.
Sociedad Mexicana de Ornitologia; holds congresses and meetings, promotes research and publishes the journal "Centzontle".
Sociedad Mexicana para el Estudio de Mamiferos Marinos; holds meetings and promotes research on marine mammals.
National Audubon Society; carries out research, particularly censuses and population studies.

Progress in Wetland Conservation and Research

Protected areas are established by Presidential Decree under sections of the Ley Organica de la Administracion Publica Federal, and are published in the official gazette of the Federation. Responsibility for the protected areas and their administration can be vested in one of several governmental agencies or various other bodies (e.g. SARH, SEDUE and INIREB).

The Mexican system of conservation areas includes Faunal Reserves, Refuges, Sanctuaries, National Parks, Biological Reserves and Biosphere Reserves. Mexico's first National Park was established in 1917. At the present time, Mexico has fifteen protected areas designated as Faunal Reserves, and there are plans to add at least a further thirty-five sites in this category. It is estimated that the total area under protection in Mexico is 28,000,000 ha, but this figure is unconfirmed and the boundaries of the majority of the protected areas have still not been legally established.

Research programmes in Mexico which include studies of wetlands and/or waterfowl include the following:

a) Aerial censuses, principally of Ciconiiformes and shorebirds, along the Gulf coast, on several occasions since 1971 (National Audubon Society).
b) Mid-winter aerial censuses of Anatidae throughout the country, almost annually since 1937 (U.S. Fish and Wildlife Service).
c) An avifaunal survey of Quintana Roo (A. Lopez Ornat).
d) Studies of the flamingos *Phoenicopterus ruber* in Yucatan (A. Rogel Bahena).
e) An inventory of Mexico's aquatic flora and fauna (Direccion de Flora y Fauna Acuaticas).
f) Numerous studies of wetlands and waterfowl in the Nearctic zone of Mexico, by Mexican scientists and also visiting scientists, e.g. at Lago Texcoco, at Laguna Cuatro Cienagas and in Baja California.

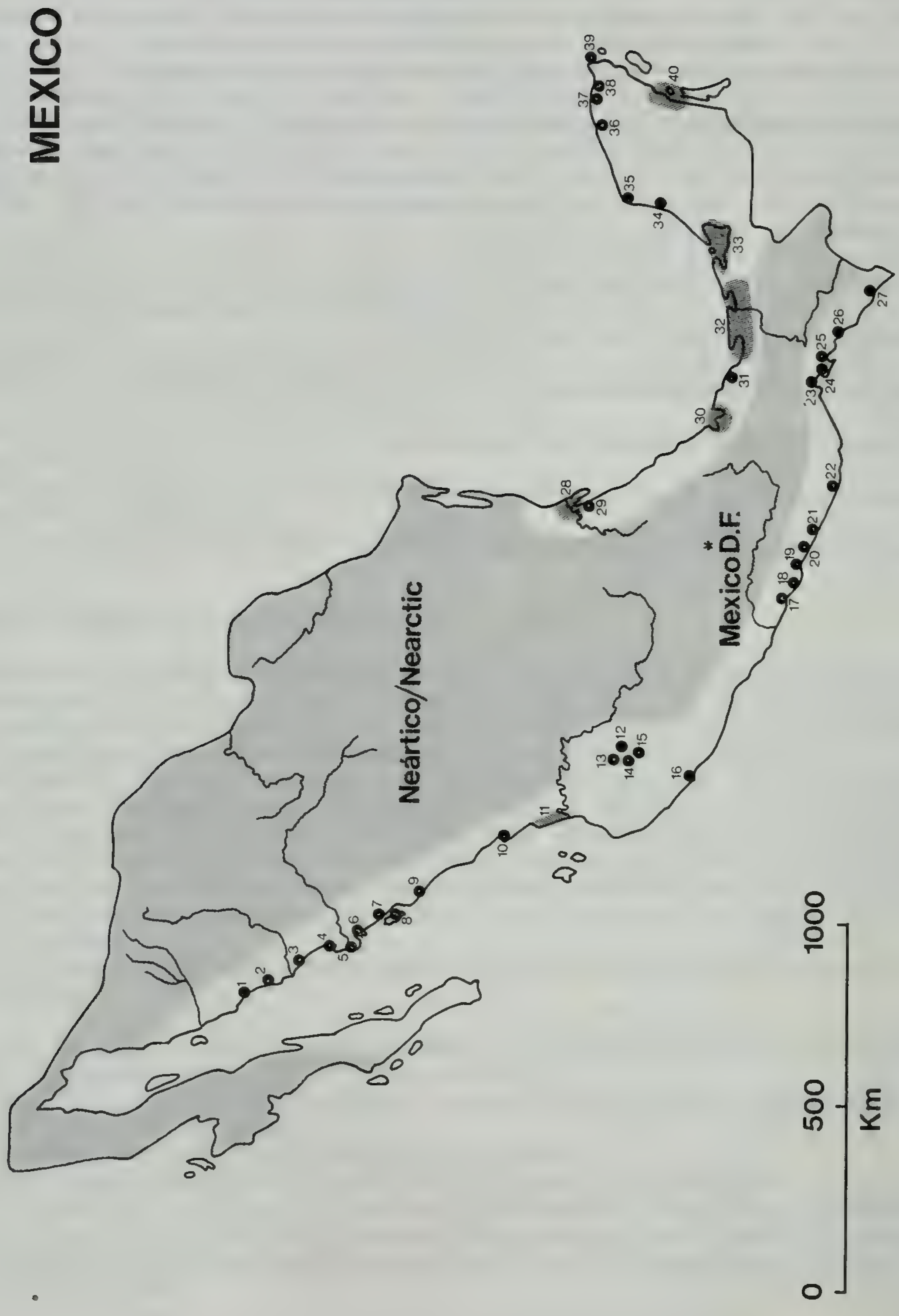
Major Threats to Wetlands and Waterfowl

The needs of agriculture, industry and urban centres have led to the drainage of lakes and marshes, diversion of water courses and creation of artificial water bodies, resulting in modifications to the flow of rivers, water tables and patterns of flooding.

Industrial waste and domestic sewage from large cities pose serious problems at wetlands both in the interior and on the coast. As a result of the population explosion in recent years, the effects of these problems have multiplied and accelerated in an unprecedented way. At the same time, the country has found itself obliged to use hydrocarbons to aid economic growth, and oil and gas pipelines have been constructed across large tracts of wetland. This problem is particularly serious in the Gulf of Mexico, where much wetland habitat has been segmented, and nesting areas and migration routes have been disturbed. No restoration measures have been employed either here or in any other situation where activities detrimental to wetlands have occurred.

Another problem which confronts conservation is that although there is a large number of areas which have been declared protected (National Parks, Faunal Reserves, Refuges, etc), many do not fulfil the objectives and criteria with which they are defined, and few of them have adequate plans for management and development.

In addition to these problems, the inefficiency of the system of hunting control is worthy of mention. The relevant legislation dates from 1952 and is no longer applicable in the present situation.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WETLANDS

Site descriptions based on data sheets provided by Antonio Rogel Bahena and Arturo Lopez Ornat, recent midwinter waterfowl censuses of the U.S. Fish and Wildlife Service, a major publication on waterfowl wintering areas in Mexico by Saunders and Saunders (1981), and other literature.

Bahia de Lobos and the Rio Yaqui Delta (1)

Location: 27°30'N, 110°35'W; 60 km west of Ciudad Obregon, Sonora.
Area: c.60,000 ha.
Altitude: 0-10m.
Province and type: 8.13.4; 01, 03, 05 & 07.
Site description: A large shallow sea bay with a sand barrier island, and adjacent brackish coastal lagoons and marshes with little aquatic vegetation. Vast areas of irrigated agricultural land have replaced the former marshes of the Yaqui Delta.
Principal vegetation: No information.
Land tenure: No information.
Protection: None.
Land use: Intensive agriculture in surrounding areas.
Waterfowl: An important wintering area for pelicans, *Branta bernicla* and ducks. The average midwinter counts from 1980 to 1984 were: 180 *Pelecanus erythrorhynchos*; 680 *P. occidentalis* (maximum 1,240); 440 *Branta bernicla*; and 8,000 ducks, mainly *Anas americana, A. crecca, A. acuta, A. clypeata, Aythya affinis* and *Mergus serrator*. 30 *Grus canadensis* were found wintering in 1971.
Other fauna: *Pandion haliaetus* winters in small numbers.
Threats: No information.
References: Knoder *et al* (1980); Norman (1979-1982); Conant & Novara (1983); Conant & Voelzer (1984).
Source: U.S. Fish & Wildlife Service and references.
Criteria for inclusion: 1b.

Isla Tobari and Cocoraquito Lagoon (2)

Location: 27°02'N, 109°57'W; 50 km south of Ciudad Obregon, Sonora.
Area: 8,000 ha.
Altitude: 0m.
Province and type: 8.13.4; 05 & 07.
Site description: A large shallow brackish coastal lagoon connected to the sea by two channels, and adjacent brackish marshes, alkaline flats and sand beaches.
Principal vegetation: Extensive beds of *Ruppia* sp; marshes with *Scirpus* sp and *Eleocharis* sp; and flats with *Batis* sp and *Salicornia* sp.
Land tenure: No information.
Protection: None.
Land use: Duck hunting; agriculture in surrounding areas.
Waterfowl: An important wintering area for pelicans, and ducks. The average midwinter counts from 1980 to 1984 were: 2,250 *Pelecanus occidentalis* (maximum 6,860); and 55,800 ducks, mainly *Anas crecca, A. americana, A. acuta, A. clypeata* and *Aythya affinis*, with several hundred *Mergus serrator*. *Anser albifrons, A. caerulescens* and *Branta bernicla* are occasional winter visitors in small numbers.
Other fauna: No information.
Threats: No information.
References: Saunders & Saunders (1981); Norman (1979-1982); Conant & Novara (1983); Conant & Voelzer (1984).
Source: U.S. Fish & Wildlife Service and references.
Criteria for inclusion: 1a & 1b.

Bahia de Santa Barbara (3)

Location: 26°43'N, 109°30'W; 100 km SSE of Ciudad Obregon, Sonora.
Area: c.10,000 ha.
Altitude: 0m.
Province and type: 8.13.4; 05 & 07.
Site description: A large shallow brackish coastal lagoon with wide connection to the sea, and adjacent sand beaches.
Principal vegetation: No information.
Land tenure: No information.
Protection: None.
Land use: No information.
Waterfowl: An important wintering area for pelicans, *Branta bernicla* and ducks. The average midwinter counts from 1980 to 1984 were: 880 *Pelecanus occidentalis* (maximum 1,875); 730 *Branta bernicla* and 55,000 ducks, mainly *Anas crecca, A. americana, A. acuta* and *A. clypeata*, with up to 2,100 *Oxyura jamaicensis* and 250 *Mergus serrator*. Numbers of *Fulica americana* have ranged from a few hundreds to over 14,000.
Other fauna: Up to 5 *Pandion haliaetus* have been recorded in winter.
Threats: No information.
References: Norman (1979-1982); Conant & Novara (1983); Conant & Voelzer (1984).
Source: U.S. Fish & Wildlife Service and references.
Criteria for inclusion: 1a & 1b.

Agiabampo Lagoons (4)

Location: 26°20'N, 109°15'W; 60 km NNW of Los Mochis, Sonora and Sinaloa.
Area: 30,000 ha.
Altitude: 0m.
Province and type: 8.13.4; 02, 05 & 07.
Site description: A complex of shallow brackish coastal lagoons including the estuaries of the Rio Agiabampo and Rio Bacorehuis, and adjacent sand beaches.
Principal vegetation: Extensive beds of *Ruppia* sp and marine algae.
Land tenure: No information.
Protection: None.
Land use: Surrounding areas of woodland have been cleared for agriculture.
Waterfowl: A very important wintering area for pelicans, geese, ducks and coots. The average midwinter counts from 1980 to 1984 were: 200 *Pelecanus erythrorhynchos*, 3,020 *P. occidentalis* (maximum 6,060); 460 *Anser albifrons*; 2,370 *Branta bernicla*; 91,000 ducks (maximum 133,500), mainly *Anas crecca, A. americana, A. acuta, A. clypeata, Aythya americana* and *A. affinis*, with up to 600 *Bucephala albeola*, 2,770 *Mergus serrator* and 17,700 *Oxyura jamaicensis*; and 7,000 *Fulica americana*. Up to 400 wintering *Grus canadensis* have been recorded on adjacent arable land.
Other fauna: *Pandion haliaetus* is a regular winter visitor, and up to seven have been recorded.
Threats: No information.
References: Saunders & Saunders (1981); Norman (1979-1982); Conant & Novara (1983); Conant & Voelzer (1984).
Source: U.S. Fish & Wildlife Service and references.
Criteria for inclusion: 1a & 1b.

Bahia de San Esteban and the mouth of the Rio Fuerte (5)

Location: 25°43'N, 109°20'W; 35 km west of Los Mochis, Sinaloa.
Area: 15,000 ha.
Altitude: 0m.
Province and type: 8.13.4; 02, 05 & 07.

Site description: A large shallow brackish coastal lagoon with a connection to the sea, the estuary of the Rio Fuerte, and adjacent sand beaches.
Principal vegetation: No information.
Land tenure: No information.
Protection: None.
Land use: No information.
Waterfowl: An important wintering area for pelicans, *Branta bernicla* and ducks. The average midwinter counts from 1980 to 1984 were: 2,700 *Pelecanus occidentalis*; 320 *Branta bernicla* and 28,000 ducks, mainly *Anas crecca, A. acuta* and *Aythya americana*, with up to 550 *Mergus serrator*. 400 *Pelecanus erythrorhynchos* were recorded in January 1982.
Other fauna: Up to 6 *Pandion haliaetus* have been recorded in winter.
Threats: No information.
References: Norman (1979-1982); Conant & Novara (1983); Conant & Voelzer (1984).
Source: U.S. Fish & Wildlife Service and references.
Criteria for inclusion: 1a & 1b.

Topolobampo Lagoons (6)

Location: 25°35'N, 109°00'W; 10 km south of Los Mochis, Sinaloa.
Area: 40,000 ha.
Altitude: 0m.
Province and type: 8.13.4; 02, 05, 07 & 17.
Site description: A complex of large brackish lagoons and shallow sea bays with little aquatic vegetation, including the 22 km long Topolobampo Lagoon (Bahia de Ohuira) and the 38 km long Bahia de Navachiste. The latter is separated from the open sea by a chain of barren islands. There are extensive areas of irrigated agricultural land nearby.
Principal vegetation: No information.
Land tenure: No information.
Protection: None.
Land use: Agriculture nearby.
Waterfowl: An extremely important wintering area for pelicans, *Branta bernicla*, ducks and coots. The average midwinter counts from 1980 to 1984 were: 280 *Pelecanus erythrorhynchos*; 2,040 *P. occidentalis*; 4,900 *Branta bernicla*; 244,000 ducks; and 36,000 *Fulicaamericana*. There was a great increase in the number of wintering ducks in the 1950s and early 1960s, with the expansion of irrigated agriculture in the region, and the lagoon is now the most important wintering area in western Mexico for *Anas crecca, A. americana, A. acuta* and *A. clypeata*. Other ducks occurring in significant numbers in recent years include *Dendrocygna bicolor* (maximum 2,820), *D. autumnalis* (maximum 5,850), *Anas strepera* (maximum 7,900), *Aythya americana* (maximum 12,200), *A. affinis* (maximum 12,300), *Bucephala albeola* (maximum 410), *Mergus serrator* (maximum 5,040), and *Oxyura jamaicensis* (maximum 2,050). A flock of up to 500 *Anser albifrons* winters in the area.
Other fauna: *Pandion haliaetus* is a common winter visitor; up to 11 have been recorded.
Threats: There are no obvious threats to the wetland habitat.
References: Saunders & Saunders (1981); Norman (1979-1982); Conant & Novara (1983); Conant & Voelzer (1984).
Source: U.S. Fish & Wildlife Service and references.
Criteria for inclusion: 1a & 1b.

Bahia de Santa Maria (7)

Location: 25°00'N, 108°10'W; 100 km southwest of Los Mochis, Sinaloa.
Area: 135,000 ha.
Altitude: 0m.
Province and type: 8.13.4; 01, 05 & 06.

Site description: A large shallow saline bay with extensive mudflats, two broad openings to the sea, and a 42 km long barrier ridge between the bay and the sea (Isla Altamura). Several small streams enter the bay, and there are many small islands.
Principal vegetation: Very extensive beds of *Ruppia* sp.
Land tenure: No information.
Protection: None.
Land use: No information.
Waterfowl: The principal wintering area for *Branta bernicla* on the mainland coast of Mexico, and a very important wintering area for pelicans, ducks and shorebirds. The average midwinter counts from 1980 to 1984 were: 360 *Pelecanus erythrorhynchos*; 3,050 *P. occidentalis*; 7,750 *Branta bernicla*; and 54,000 ducks, mainly *Anas crecca, A. acuta, A. clypeata, Aythya americana* and *A. affinis*, with up to 225 *Bucephala albeola* and 1,290 *Mergus serrator.* 113,000 shorebirds were counted in Bahia de Santa Maria and the nearby Ensenada del Pabellon (site 8) in January 1972. Other wintering birds include several hundred *Anser albifrons* and several thousand *Fulica americana.*
The bay is also a very important breeding area for many species of waterfowl. Counts of breeding pairs in 1971 and 1972 included *1,500 Pelecanus occidentalis, 4,300 Phalacrocorax* sp, *57 Nyctanassa violacea, 8,100 Bubulcus ibis, 830 Egretta caerulea, 230 E. tricolor, 41 E. rufescens, 90 E. thula, 200 E. alba, 1,750 Eudocimus albus* and *18 Ajaia ajaja.*
Other fauna: Up to 17 *Pandion haliaetus* have been recorded in winter, and five nests were located in 1984. 1,500 pairs of *Fregata magnificens* were nesting in 1971/72. Grey Whales *Eschrichtius gibbosus* occasionally enter the bay.
Threats: None known.
References: Knoder *et al* (1980); Saunders & Saunders (1981); Norman (1979-1982); Conant & Novara (1983); Conant & Voelzer (1984).
Source: U.S. Fish & Wildlife Service and references.
Criteria for inclusion: 123.

Ensenada del Pabellon and Boca de la Barra (8)

Location: 24°27'N, 107°35'W; 45 km southwest of Culiacan, Sinaloa.
Area: 80,000 ha.
Altitude: 0m.
Province and type: 8.13.4; 02, 05, 06, 07, 08 & 17.
Site description: A large coastal lagoon fringed with mangrove swamps, mudflats and brackish marshes, and with a narrow connection to the sea. The Rio Culiacan and several smaller streams flow into the bay. Salinities range from saline in the north, near the connection to the sea, to almost fresh in the south, where there are extensive marshes. There are salt flats and tidal pools adjacent to the lagoon, and extensive areas of irrigated agricultural land nearby.
Principal vegetation: Beds of *Ruppia* sp; brackish marshes with species of *Eleocharis, Scirpus* and *Salicornia*; and mangrove swamps.
Land tenure: A portion of the area is owned by a local hunting club.
Protection: None.
Land use: Sport hunting.
Waterfowl: One of the most important wintering areas for ducks in western Mexico, and a very important area for pelicans, coots and shorebirds. The average midwinter counts from 1980 to 1984 included 320 *Pelecanus erythrorhynchos*; 1,250 *P. occidentalis*; 301,000 ducks, mainly *Anas crecca, A. acuta, A. discors* and *A. clypeata*; and 20,500 *Fulica americana.* 113,000 shorebirds were counted in this area and nearby Bahia de Santa Maria (site 7) in January 1972. Other wintering birds include up to 2,930 *Anser albifrons* and occasional small groups of *A. caerulescens.*
The bay is also a very important breeding area for waterfowl. Counts of breeding pairs in 1971 and 1972 included 5,000 *Pelecanus occidentalis, 30 Nyctanassa violacea, 6,300 Bubulcus ibis, 50 Egretta caerulea, 50 E. tricolor, 500 E. thula, 200 E. alba, 20 Ardea herodias* and 500 *Eudocimus albus.*
Other fauna: *Pandion haliaetus* winters in small numbers, and there is a breeding colony of *Fregata magnificens* (600 pairs in 1971/72).

Threats: Some wetland habitat may be lost with the construction of a dam in the area.
References: Knoder *et al* (1980); Saunders & Saunders (1981); Norman (1979-1982); Conant & Novara (1983); Conant & Voelzer (1984).
Source: U.S. Fish & Wildlife Service and references.
Criteria for inclusion: 123.

Coastal lagoons between El Dorado and Dimas (9)

Location: 24°10'N, 107°15'W; 75 km SSE of Culiacan, Sinaloa.
Area: 25,000 ha.
Altitude: 0m.
Province and type: 8.13.4; 07.
Site description: A chain of brackish coastal lagoons and marshes stretching for 55 km between El Dorado and Dimas; subject to wide fluctuations in water level, with much of the basins drying out in dry years.
Principal vegetation: Extensive beds of *Ruppia* sp.
Land tenure: No information.
Protection: None.
Land use: Surrounding areas of scrub woodland have been cleared for agriculture.
Waterfowl: An important wintering area for pelicans, geese and ducks, the importance varying greatly from year to year according to water levels. The average midwinter counts from 1979 to 1982 were: 95 *Pelecanus erythrorhynchos*; 760 *P. occidentalis*; 3,450 *Anser albifrons*; and 155,000 ducks, mainly *Anas crecca, A. acuta* (up to 131,000) and *A. discors*, with up to 7,900 *Dendrocygna autumnalis.*
Other fauna: Up to 17 *Pandion haliaetus* have been recorded in winter.
Threats: No information.
References: Saunders & Saunders (1981); Norman (1979-1982).
Source: U.S. Fish & Wildlife Service and references.
Criteria for inclusion: 1a & 1b.

Laguna Caimanero (10)

Location: 22°57'N, 106°04'W; 40 km southeast of Mazatlan, Sinaloa.
Area: 22,000 ha.
Altitude: 0m.
Province and type: 8.13.4; 02, 05, 07 & 13.
Site description: A shallow brackish coastal lagoon with fringing mudflats, stretching for 32 km between the deltas of the Rio del Presidio and Rio del Baluarte; cut off from the sea except at very high tides and subject to wide fluctuations in water level according to rainfall. There are many small freshwater ponds and marshes on the narrow sand barrier between the lagoon and the sea.
Principal vegetation: Extensive beds of *Ruppia* sp; and marshes with species of *Scirpus, Cynodon* and other Gramineae.
Land tenure: No information.
Protection: None.
Land use: Grazing of domestic livestock.
Waterfowl: A very important wintering area for pelicans, ducks, coots and shorebirds. The average midwinter counts from 1979 to 1982 included 2,580 *Pelecanus erythrorhynchos*; 640 *P. occidentalis*; and 75,000 ducks, mainly *Anas crecca, A. americana, A. acuta, A. clypeata, Aythya affinis* (up to 16,400) and *Oxyura jamaicensis* (up to 11,550). Numbers of *Fulica americana* have ranged from nil to 245,000. 200,000 shorebirds were counted in January 1979, and the lagoon regularly holds thousands of wintering *Recurvirostra americana.* 150 pairs of *Phalacrocorax* sp were nesting in 1971.
Other fauna: *Pandion haliaetus* winters in small numbers.
Threats: No information.

References: Saunders & Saunders (1981); Norman (1979-1982).
Source: U.S. Fish & Wildlife Service and references.
Criteria for inclusion: 1a & 1b.

Marismas Nacionales (11)

Location: 21°32'N, 105°15'W to 22°45'N, 105°50'W; 60-210 km SSE of Mazatlan, Sinaloa and Nayarit.
Area: 200,000 ha.
Altitude: 0-10m.
Province and type: 8.13.4; 02, 06, 07, 08 & 09.
Site description: A vast network of brackish coastal lagoons, mangrove swamps, mudflats and marshes, fed by the Rio de Acaponeta and other tributary streams, and including the delta of the Rio San Pedro. There is a single direct connection with the sea near Teacapan. The extent of the marshes varies greatly according to rainfall; during the rainy season, large areas around San Blas are flooded with brackish water forming extensive lagoons.
Principal vegetation: Mangrove swamps with *Rhizophora mangle* dominant along the rivers and deeper inlets, and *Avicennia germinans* and *Laguncularia racemosa* dominant around the lagoons; extensive beds of *Ruppia* sp; and marshes with species of *Scirpus* and *Eleocharis*. In the dry tropical forest zone.
Land tenure: No information.
Protection: None.
Land use: Fishing; tourist recreation and duck hunting in some areas.
Waterfowl: An extremely important area for both breeding and wintering waterfowl of a wide variety of species. Recent midwinter counts have included up to 4,200 *Phalacrocorax* sp, 10,000 *Pelecanus erythrorhynchos, 1,320 P. occidentalis, 8,940 Bubulcus ibis, 3,150 Egretta caerulea, 9,400 E. thula, 8,360 E. alba, 1,560 Ardea herodias, 6,280 Mycteria americana, 1,430 Eudocimus albus, 1,590 Ajaia ajaja, 15,200 Dendrocygna autumnalis, 12,100 D. bicolor, 2,200 Anser caerulescens, 42,000 Anas crecca, 29,300 A. strepera, 10,500 A. americana, 58,000 A. acuta, 37,500 A. discors/cyanoptera, 110,000 A. clypeata, 8,770 Aythya affinis, 2,300 Oxyura jamaicensis, 400 Grus canadensis, 43,000 Fulica americana*, and an estimated total of 204,000 shorebirds. From 1979 to 1982, the average number of ducks in midwinter was 178,000.
Common breeding species include *Phalacrocorax olivaceus, Anhinga anhinga, Nycticorax nycticorax, Nyctanassa violacea, Cochlearius cochlearius, Egretta tricolor, E. thula, E. alba, Ardea herodias* (250 pairs in 1979), *Mycteria americana, Ajaia ajaja, Dendrocygna autumnalis* and *D. bicolor*. *Cairina moschata* and *Oxyura dominica* also breed, but in much smaller numbers.
Other fauna: *Pandion haliaetus* is a common winter visitor; 106 were observed during the midwinter wildfowl counts in 1982. *Leo onca* and *Crocodylus acutus* still occur, but are now rare.
Threats: The area is under serious threat from squatting and development for tourism, particularly in the south near San Blas. Following a series of dry seasons from 1978 to 1982, water levels became much reduced, particularly in the north and east.
Research and conservation: The Marismas Nacionales constitute one of the last large wetland areas still intact on the Pacific coast of Mexico. A variety of studies have been conducted on the flora and fauna. N. J. Scott carried out a study of the breeding Anatidae of the Marismas between 1980 and 1983, and made some recommendations concerning their management and the establishment of appropriate reserves.
References: Dickerman & Juarez (1971); Burger *et al* (1978); Knoder *et al* (1980); Saunders & Saunders (1981); Norman (1979-1982); Scott (1984).
Source: U.S. Fish & Wildlife Service and references.
Criteria for inclusion: 123.

Lago Chapala and the Rio Lerma Delta (12)

Location: 20°15'N, 103°00'W; 40 km south and southeast of Guadalajara, Jalisco and Michoacan.
Area: Lago Chapala 112,500 ha; delta marshes formerly c.100,000 ha, now only a few thousand ha.
Altitude: 1,500m.
Province and type: 8.14.4; 09, 11 & 12.
Site description: A large permanent freshwater lake, the largest lake in Mexico, fed primarily by the Rio Lerma, with extensive delta marshes at the river mouth. Increased siltation rates are causing a gradual decrease in water depth, which now does not exceed 10m. Diking and drainage have greatly reduced the extent of the marshes, and the spread of Water Hyacinth *Eichhornia crassipes* has reduced the amount of open water.
Principal vegetation: Marshes with species of *Ruppia, Chara, Scirpus, Polygonum*, sedges and grasses; and extensive beds of *Eichhornia crassipes*. Irrigated agricultural land in surrounding areas.
Land tenure: No information.
Protection: None.
Land use: Fishing, sport hunting, and recreation including water sports; agriculture in surrounding areas.
Waterfowl: A very important wintering area for ducks, coots and shorebirds, and an important breeding area for a variety of Ardeidae. Midwinter counts from 1978 to 1982 included an average of 132,000 ducks, mainly *Anas crecca, A. americana, A. acuta, A. discors/cyanoptera* and *Aythya affinis*; and 51,500 *Fulica americana.* The ducks also included up to 11,620 *Anas (platyrhynchos) diazi* (about 20% of the total population) and up to 6,350 *Aythya valisineria.* There has been a tremendous decline in Anatidae numbers this century; duck numbers have dropped from around 500,000 in the 1930s, and geese have almost disappeared. By January 1982, the Lerma marshes had been almost totally destroyed, and only 665 ducks were located in that area.
A breeding colony of Ardeidae located in the Lerma Delta in 1975 contained 75 pairs of *Bubulcus ibis*, 15 pairs of *Egretta caerulea*, 350 pairs of *Egretta thula* and 75 pairs of *Egretta alba. Pelecanus erythrorhynchos, Mycteria americana* and *Ajaia ajaja* occur in small numbers in summer, but do not breed.
Other fauna: No information.
Threats: The many threats include siltation as a result of soil erosion on the surrounding hills; extensive diking and drainage of the delta marshes for agriculture; the spread of *Eichhornia crassipes*; reduced flow in the Rio Lerma with the utilization of its water for irrigation; pollution from nearby villages; excessive hunting; and a general increase in human population pressure throughout the region.
References: Williams (1977); Knoder *et al* (1980); Saunders & Saunders (1981); Norman (1979-1982).
Source: U.S. Fish & Wildlife Service and references.
Criteria for inclusion: 1a, 1b, 2b & 3a.

Lago de Atotonilco (13)

Location: 20°18'N, 103°33'W; 40 km southwest of Guadalajara, Jalisco.
Area: 7,200 ha.
Altitude: 1,350m.
Province and type: 8.14.4; 14.
Site description: Two shallow, highly alkaline lakes with little aquatic vegetation. Formerly a single lake, but sedimentation and declining water levels divided the lake into two. Water levels fluctuate widely according to local rainfall, and the southern basin is dry in most years.
Principal vegetation: Some *Scirpus californicus.*
Land tenure: No information.
Protection: None.
Land use: Livestock grazing on the shores.
Waterfowl: An important breeding area for Ardeidae, and wintering area for ducks, geese and

shorebirds. Midwinter counts from 1977 to 1982 included an average of 10,400 ducks, mainly *Anas crecca, A. americana, A. acuta, A. discors/cyanoptera* and *A. clypeata*, with up to 1,690 *Anas (platyrhynchos) diazi*. Numbers of *Anser caerulescens* have ranged from nil to 3,500. The area is particularly important for wintering *Recurvirostra americana*. A breeding colony of Ardeidae located in 1978 contained 100 pairs of *Nycticorax nycticorax*, 200 pairs of *Bubulcus ibis*, 300 pairs of *E. thula* and 200 pairs of *E. alba*.
Other fauna: No information.
Threats: No information.
References: Knoder *et al* (1980); Saunders & Saunders (1981); Norman (1979-1982).
Source: U.S. Fish & Wildlife Service and references.
Criteria for inclusion: 1a, 1b, & 3a.

Laguna de Sayula (14)

Location: 20°00'N, 103°33'W; 70 km SSW of Guadalajara, Jalisco.
Area: 12,000 ha.
Altitude: 1,350m.
Province and type: 8.14.4; 14.
Site description: A large seasonal highly alkaline lake with no aquatic vegetation; in an inland drainage basin. The lake is largely or entirely dry in drought years.
Principal vegetation: None.
Land tenure: No information.
Protection: None.
Land use: Livestock grazing in surrounding areas.
Waterfowl: An important wintering area for ducks, geese, coots and shorebirds, particularly in wet years. Midwinter counts from 1977 to 1980 included up to 55,000 ducks, mainly *Anas crecca, A. acuta* and *A. clypeata*; up to 2,325 *Anser caerulescens*; and up to 11,600 *Fulica americana*. A breeding colony of 150 pairs of *Egretta alba* was located in 1974 and 1975, and up to 100 *Plegadis chihi* and 400 *Anas (platyrhynchos) diazi* have been recorded in summer.
Other fauna: No information.
Threats: No information.
References: Williams (1977); Knoder *et al* (1980); Saunders & Saunders (1981); Norman (1979-1982).
Source: U.S. Fish & Wildlife Service and references.
Criteria for inclusion: 1a & 3a.

Laguna Zapotlan (15)

Location: 19°45'N, 103°30'W; near Ciudad Guzman, Jalisco.
Area: 1,700 ha.
Altitude: 1,510m.
Province and type: 8.14.4; 12.
Site description: A freshwater lake, about 1m deep, with fringing marshes.
Principal vegetation: Extensive beds of *Typha* sp; also species of *Scirpus, Ruppia, Eleocharis* and sedges.
Land tenure: No information.
Protection: None.
Land use: Reed-cutting for handicrafts, and hunting.
Waterfowl: An important breeding area for herons and ibises; colonies in 1974, 1975 and 1978 included up to 75 pairs of *Nycticorax nycticorax*, 75 pairs of *Bubulcus ibis*, 5 pairs of *Egretta caerulea*, 200 pairs of *E. thula*, 50 pairs of *E. alba* and 30 pairs of *Plegadis chihi*. Small numbers of ducks and *Fulica americana* occur in winter.
Other fauna: No information.
Threats: No information.

References: Williams (1977); Knoder *et al* (1980); Saunders & Saunders (1981).
Source: See references.
Criteria for inclusion: 3a.

Laguna Cuyutlan (16)

Location: 19°00'N, 104°10'W; east of Manzanillo, Colima.
Area: 9,500 ha.
Altitude: 0m.
Province and type: 8.14.4; 05, 07, 08 & 13.
Site description: A large brackish coastal lagoon with mangrove swamps, recently divided into two sections as a result of siltation; and adjacent small freshwater ponds and marshes. The lagoon is fed by many small streams, and receives water from the Rio Armeria when that floods. The lagoon is cut off from the sea by a sand barrier, but there is some inflow of sea water during storms. Salinities and water levels fluctuate widely.
Principal vegetation: Beds of *Ruppia* sp and *Chara* sp; brackish marshes with species of *Scirpus, Eleocharis* and *Salicornia*, particularly along the east shore; freshwater marshes with species of *Typha* and *Pistia*; and mangrove swamps.
Land tenure: No information.
Protection: None.
Land use: The lagoon supports an important fishery, and there is a salt extraction operation nearby.
Waterfowl: An important breeding, passage and wintering area for a wide variety of waterfowl. Breeding birds include up to 8,000 pairs of *Phalacrocorax* sp, 100 pairs of *Egretta alba*, 10,000 pairs of *Larus atricilla* and smaller numbers of *Pelecanus occidentalis* and *Ajaia ajaja*. The lagoon is a very important feeding area for large numbers of migrant Ardeidae, shorebirds and Laridae, and an important wintering area for pelicans, ducks and coots. The average midwinter counts from 1979 to 1982 included 400 *Pelecanus erythrorhynchos*, 510 *P. occidentalis*, 15,800 ducks (mainly *Dendrocygna autumnalis, Anas acuta, A. clypeata* and *Aythya affinis*), and 34,000 *Fulica americana.*
Other fauna: *Pandion haliaetus* is a regular winter visitor.
Threats: The nearby town of Manzanillo is expanding rapidly as a tourist resort, and there is a threat of habitat destruction for housing and hotel development.
References: Knoder *et al* (1980); Saunders & Saunders (1981); Norman (1979-1982).
Source: U.S. Fish & Wildlife Service and references.
Criteria for inclusion: 1a, 1b & 3a.

Laguna Mitla (17)

Location: 17°02'N, 100°20'W; 50 km WNW of Acapulco, Guerrero.
Area: 6,000 ha.
Altitude: 0m.
Province and type: 8.14.4; 05, 07, 08, 13 & 17.
Site description: A shallow brackish coastal lagoon with mangrove swamps, separated from the sea by a sand barrier, and with adjacent small freshwater ponds and marshes. There are large areas of rice cultivation nearby.
Principal vegetation: Extensive beds of *Ruppia* sp; marshes with species of *Typha, Scirpus, Eleocharis* and *Cynodon*; mangrove swamps; and rice fields.
Land tenure: No information.
Protection: None.
Land use: No information.
Waterfowl: An important wintering area for pelicans, ducks and coots. Recent midwinter counts have included up to 1,000 *Pelecanus erythrorhynchos*, 14,000 ducks (mainly *Anas acuta, A. discors/cyanoptera* and *Aythya affinis*), and 25,000 *Fulica americana.* Breeding birds include up to 2,900 pairs of *Phalacrocorax* sp.
Other fauna: No information.

Threats: No information.
References: Knoder *et al* (1980); Saunders & Saunders (1981); Norman (1979-1982).
Source: U.S. Fish & Wildlife Service and references.
Criteria for inclusion: 1a & 3a.

Laguna de Coyuca (18)

Location: 16°55'N, 100°00'W; 15 km WNW of Acapulco, Guerrero.
Area: 5,000 ha.
Altitude: 0m.
Province and type: 8.14.4; 05, 07, 08 & 13.
Site description: A fairly deep and slightly brackish coastal lagoon with extensive mangrove swamps along its northeastern shore; separated from the sea by a sand barrier with grassy marshes. The lagoon has no connection with the sea, and the water level remains rather stable.
Principal vegetation: Marshes with species of *Typha, Scirpus, Eleocharis* and *Cynodon*, particularly along the northwest shore; ponds with some *Eichhornia* sp; and mangrove swamps.
Land tenure: No information.
Protection: None.
Land use: No information.
Waterfowl: Formerly an important wintering area for ducks, but numbers have declined greatly in recent years. The area remains important for passage and wintering shorebirds, and there are some breeding waterfowl.
Other fauna: No information.
Threats: The main threats are expansion of tourist facilities from nearby Acapulco, and possible runway extension at a military airport on the west side of the lagoon.
References: Knoder *et al* (1980); Saunders & Saunders (1981); Norman (1979-1982).
Source: U.S. Fish & Wildlife Service and references.
Criteria for inclusion: 3a.

Laguna Papagayo (Tres Palos) (19)

Location: 16°45'N, 99°45'W; 20 km ESE of Acapulco, Guerrero.
Area: 7,500 ha.
Altitude: 0m.
Province and type: 8.14.4; 05, 07 & 13.
Site description: A relatively deep brackish coastal lagoon with fresh to brackish marshes; separated from the sea by a barrier beach. During heavy rains, the nearby Rio Papagayo floods into the lagoon which becomes almost fresh.
Principal vegetation: Beds of *Ruppia* sp and *Chara* sp; marshes with species of *Scirpus, Polygonum, Castalia, Nymphaea* and *Eleocharis.*
Land tenure: No information.
Protection: None.
Land use: Hunting, recreation and livestock grazing.
Waterfowl: An important lagoon for passage and wintering shorebirds. Formerly an important wintering area for ducks, with up to 80,000 in the 1940s, but numbers have declined greatly, possibly as a result of excessive disturbance from hunting.
Other fauna: No information.
Threats: The lagoon has been much disturbed by hunters in power boats. The habitat is now under threat from tourist development and the possible extension of runways at the main Acapulco Municipal Airport on the west side of the lagoon. Construction of residential sites has already commenced on the barrier beach between the lagoon and the sea.
References: Saunders & Saunders (1981); Norman (1979-1982).
Source: U.S. Fish & Wildlife Service and references.
Criteria for inclusion: 3a.

Laguna de San Marcos (20)

Location: 16°40'N, 99°20'W; 60 km ESE of Acapulco, Guerrero.
Area: 3,500 ha.
Altitude: 0m.
Province and type: 8.14.4; 05 & 07.
Site description: A brackish coastal lagoon with abundant submergent aquatic vegetation and broad fringing marshes; separated from the sea by a barrier beach. The lagoon is fed by several small streams, and at high water levels, overflows into the sea through a temporary channel at the east end.
Principal vegetation: In a region of dry thorn forest and savanna.
Land tenure: No information.
Protection: None.
Land use: No information.
Waterfowl: Formerly a very important wintering area for ducks, with up to 114,000 in the 1940s, but numbers have declined greatly. In recent years, numbers of ducks have varied widely from a few thousand to 31,000 (in 1981), mainly *Anas americana* and *Aythya affinis*. Numbers of *Fulica americana* have varied from a few hundred to over 17,000. Other wintering birds have included up to 40 *Ajaia ajaja*.
Other fauna: No information.
Threats: No information.
References: Saunders & Saunders (1981); Norman (1979-1982).
Source: U.S. Fish & Wildlife Service and references.
Criteria for inclusion: 1a.

Laguna Nexpa (21)

Location: 16°37'N, 99°05'W; 90 km ESE of Acapulco, Guerrero.
Area: 4,500 ha.
Altitude: 0m.
Province and type: 8.14.4; 05 & 07.
Site description: A brackish coastal lagoon with extensive fringing marshes; separated from the sea by a barrier beach. At high water levels, the lagoon overflows into the sea through channels at both ends.
Principal vegetation: In a region of dry thorn forest and savanna.
Land tenure: No information.
Protection: None.
Land use: No information.
Waterfowl: Formerly an important wintering area for ducks, with up to 50,000 in the 1940s, but only a few thousands have been recorded in recent years, mainly *Aythya affinis*. Other wintering birds have included small numbers of *Pelecanus occidentalis*, *Ajaia ajaja* and *Fulica americana*. A breeding colony of 650 pairs of *Phalacrocorax* sp was located in 1972.
Other fauna: No information.
Threats: No information.
References: Saunders & Saunders (1981); Norman (1979-1982).
Source: U.S. Fish & Wildlife Service and references.
Criteria for inclusion: 3a.

Coastal lagoons from Laguna Alotengo to Puerto Escondido (22)

Location: 16°12'N, 98°10'W to 15°53'N, 97°05'W; 150 km southwest of Oaxaca, Oaxaca.
Area: 9,000 ha of lagoons.
Altitude: 0-50m.
Province and type: 8.14.4; 02, 05, 07 & 08.

Site description: A chain of permanent brackish to highly saline coastal lagoons with mangrove swamps and brackish marshes; associated seasonal marshes flooded between March and November; and the deltas of the Rio Santa Catarina and Rio Verde. The lagoons and marshes are separated from the sea by a barrier beach. The principal lagoons are Laguna Alotengo (2,700 ha), Lagunas de Chacahua (800 ha) and Laguna Pastoria (2,200 ha). Salinities range up to 45 p.p.t.

Principal vegetation: Mangrove swamps with *Avicennia germinans, Laguncularia racemosa, Conocarpus erectus* and *Rhizophora mangle*; fresh and brackish marshes; wet savanna; and sand dune vegetation. In a region of dry tropical forest.

Land tenure: A mixture of state, local government and private ownership.

Protection: 3,525 ha of wetlands including Lagunas de Chacahua and Laguna Pastoria are protected within the Lagunas de Chacahua National Park (14,187 ha) established in 1937. Other areas are unprotected.

Land use: Fishing, extraction of salt on a small scale, and tourist recreation.

Waterfowl: A very important breeding area for waterfowl, and an important passage and wintering area for Anatidae and shorebirds. Breeding birds include *Phalacrocorax olivaceus* (500 pairs), *Anhinga anhinga* (50 pairs), *Nycticorax nycticorax* (50 pairs), *Cochlearius cochlearius* (300 pairs), *Bubulcus ibis* (200 pairs), *Egretta tricolor* (600 pairs), *E. thula* (600 pairs), *E. alba* (200 pairs), *Mycteria americana* (200 pairs), *Eudocimus albus* (25 pairs), *Ajaia ajaja* (250 pairs), *Himantopus himantopus* (10 pairs), and *Sterna albifrons* (10 pairs). *Jacana spinosa* also breeds. Wintering birds in recent years have included up to 105 *Pelecanus occidentalis*, small numbers of *Ajaia ajaja*, up to 26,000 Anatidae (mainly *Aythya affinis*), and 1,200 *Fulica americana*.

Other fauna: *Pandion haliaetus* occurs in winter. A wide variety of mammals have been recorded in the National Park, including *Felis pardalis, Canis latrans* and *Odocoileus virginianus*. The freshwater turtles *Kinosternon cruentatum* and *Pseudemys scripta* occur in the lagoons, and the sea turtles *Lepidochelys olivacea, Eretmochelys imbricata* and *Dermochelys coriacea* occur along the coast.

Threats: There are problems in the National Park with disturbance and destruction of nesting habitat, forestry activities, and uncontrolled tourism.

References: Vargas (1974); Gallina & Sangri (1979); Saunders & Saunders (1981); Norman (1979-1982).

Source: Antonio Rogel Bahena, U.S. Fish & Wildlife Service and references.

Criteria for inclusion: 1a, 2c & 3a.

Laguna Superior (23)

Location: 16°20'N, 94°55'W; 30 km east of Tehuantepec, Oaxaca.

Area: 37,500 ha.

Altitude: 0m.

Province and type: 8.14.4; 05 & 07.

Site description: A large shallow saline lagoon with several islands and extensive fringing mudflats; separated from the sea by a barrier beach, and with a wide connection with the sea in the southeast. The lagoon is fed by several intermittent streams and waste irrigation water from nearby agricultural land.

Principal vegetation: Beds of *Ruppia* sp and *Chara* sp.

Land tenure: No information.

Protection: None.

Land use: No information.

Waterfowl: An important wintering area for ducks, with an average of 21,000 in the years 1977 to 1980, mainly *Anas acuta, A. discors/cyanoptera* and *Aythya affinis*.

Other fauna: There was a breeding colony of 10,000 pairs of *Fregata magnificens* in 1977.

Threats: No information.

References: Knoder *et al* (1980); Saunders & Saunders (1981); Norman (1979-1982).

Source: U.S. Fish & Wildlife Service and references.

Criteria for inclusion: 1a & 3a.

Laguna Inferior (24)

Location: 16°17'N, 94°40'W; 60 km east of Tehuantepec, Oaxaca.
Area: 42,500 ha.
Altitude: 0m.
Province and type: 8.14.4; 05 & 07.
Site description: A large shallow brackish lagoon with muddy shoreline and little aquatic vegetation; separated from the sea by a barrier beach, and with wide connections to Laguna Superior to the west, and to the sea. The lagoon is fed by the Rio Niltepec which enters at the north end.
Principal vegetation: No information.
Land tenure: No information.
Protection: None.
Land use: No information.
Waterfowl: Formerly an important wintering area for ducks, with a midwinter average of 22,500 in the 1950s and early 1960s, but under 10,000 in recent years. The predominant species are *Anas acuta, A. discors/cyanoptera, A. clypeata* and *Aythya affinis*. Other wintering birds include up to 300 *Pelecanus occidentalis*, small numbers of *Ajaia ajaja*, and 2,000 *Fulica americana*. A small breeding colony of *Egretta alba* was discovered in 1975.
Other fauna: No information.
Threats: No information.
References: Knoder *et al* (1980); Saunders & Saunders (1981); Norman (1979-1982).
Source: U.S. Fish & Wildlife Service and references.
Criteria for inclusion: 3a.

Mar Muerto (25)

Location: 16°10'N, 94°10'W; 100 km east of Tehuantepec, Oaxaca and Chiapas.
Area: 60,000 ha.
Altitude: 0m.
Province and type: 8.14.4/8.16.4; 05 & 07.
Site description: A large shallow brackish lagoon with muddy shoreline and several islands; connected with the sea by two channels. The lagoon is fed by several small streams.
Principal vegetation: No information.
Land tenure: No information.
Protection: None.
Land use: No information.
Waterfowl: A very important breeding area for waterfowl, and an important wintering area for pelicans and ducks. Censuses of breeding birds between 1972 and 1979 included up to 4,300 pairs of *Phalacrocorax* sp, 300 pairs of *Egretta caerulea*, 300 pairs of *E. tricolor*, 150 pairs of *E. rufescens*, 3,500 pairs of *E. thula*, 3,475 pairs of *E. alba*, 225 pairs of *Mycteria americana*, and very large numbers of *Eudocimus albus*. Wintering birds have included several thousand *Pelecanus erythrorhynchos*, up to 380 *P. occidentalis*, and up to 16,000 ducks, mainly *Aythya affinis*.
Other fauna: *Pandion haliaetus* occurs in winter. Very large concentrations of *Fregata magnificens* have been recorded; up to 3,000 pairs have been found nesting, and almost 19,000 birds were observed in July 1972.
Threats: No information.
References: Knoder *et al* (1980); Saunders & Saunders (1981); Norman (1979-1982).
Source: U.S. Fish & Wildlife Service and references.
Criteria for inclusion: 1b, 2b & 3a.

Laguna de La Joya (26)

Location: 15°56'N, 93°40'W; 16 km southeast of Tonala, Chiapas.
Area: 3,800 ha.
Altitude: 0-5m.
Province and type: 8.16.4; 07 & 08.
Site description: A shallow, slightly brackish coastal lagoon with several small islands covered with mangroves, and extensive mangrove swamps between it and the sea. The water level fluctuates considerably according to local rainfall, and there is some inflow of sea water during the highest tides.
Principal vegetation: Mangrove swamps; otherwise no aquatic vegetation other than phytoplankton and algae.
Land tenure: No information.
Protection: None.
Land use: No information.
Waterfowl: Formerly a very important wintering area for Anatidae, with a midwinter average of 77,000 ducks, mainly *Anas discors* and *A. clypeata*, in the 1950s and early 1960s. Numbers have declined dramatically, and the midwinter average from 1978 to 1980 was only 8,500. Other wintering birds in recent years have included up to 270 *Pelecanus occidentalis* and small numbers of *Mycteria americana* and *Ajaia ajaja.*
Other fauna: *Pandion haliaetus* occurs in winter.
Threats: No information.
References: Saunders & Saunders (1981); Norman (1979-1982).
Source: U.S. Fish & Wildlife Service and references.
Criteria for inclusion: 3a.

Coastal lagoons in the Sesecapa area (27)

Location: 15°45'N, 93°30'W to 14°35'N, 92°15'W; from 50 km southeast of Tonala to the Guatemalan border, Chiapas.
Area: c.70,000 ha.
Altitude: 0-5m.
Province and type: 8.16.4; 07, 12 & 13.
Site description: A chain of fresh to brackish coastal lagoons and marshes stretching for 200 km along the narrow marshy coastal plain between Pijijiapan and the Guatemalan border. The principal lagoons are the Laguna del Viejo complex (60,000 ha), Laguna de Buenavista, Laguna de Los Patos and Laguna de Solo Dios. The lagoons are fed by numerous small streams from the nearby mountains, and most are deep with a dense growth of aquatic vegetation.
Principal vegetation: Dense growths of *Eichhornia* sp, *Pontaderia* sp, etc.
Land tenure: No information.
Protection: None.
Land use: Adjacent lands are being cleared of forest for agriculture and livestock grazing.
Waterfowl: An important breeding, passage and wintering area for a wide variety of waterfowl. In 1979, the breeding birds included 1,000 pairs of *Phalacrocorax* sp, 1,600 pairs of *Egretta alba*, 350 pairs of *Mycteria americana*, and 75 pairs of *Ajaia ajaja.* Wintering birds in recent years have included up to 330 *Pelecanus occidentalis*, 1,130 *Mycteria americana*, and 86,000 ducks, mainly *Dendrocygna autumnalis*, *Anas discors/cyanoptera*, *A. clypeata* and *Aythya affinis.* Up to 5,400 *Dendrocygna bicolor* and 1,280 *Cairina moschata* were recorded in winter in the late 1950s and early 1960s, but only small numbers have been observed in recent years. The area is also known to be very important for passage and wintering shorebirds.
Other fauna: Up to eight *Pandion haliaetus* have been recorded in winter.
Threats: The diversion of water supplies for irrigation, and encroachment of agriculture are reducing the amount of wetland habitat.
References: Knoder *et al* (1980); Saunders & Saunders (1981); Norman (1979-1982).
Source: U.S. Fish & Wildlife Service and references.
Criteria for inclusion: 1a & 3a.

Deltas of the Rio Tamesi and Rio Panuco, and the Tampico Lagoons (28)

Location: 22°12'N, 98°00'W; around and west of the city of Tampico, Tamaulipas, Veracruz and San Luis Potosi.
Area: 54,000 ha of wetlands in a region of 403,500 ha.
Altitude: 0-30m.
Province and type: 8.1.1; 02, 09, 12, 13 & 17.
Site description: The northernmost large delta region on the Gulf coast within the tropical zone. A complex of shallow freshwater lakes and marshes in the valleys of the Rio Tamesi and Rio Panuco, subject to extensive inundation during the rainy season. The extent of flooding varies greatly from year to year; in very wet years, large areas of adjacent agricultural land are also flooded.
Principal vegetation: Extensive marshes with *Cladium sp, Scirpus sp, Typha* sp and *Eleocharis* sp; lakes and ponds with floating beds of *Eichhornia* sp and *Nymphoides* sp; and wet agricultural land.
Land tenure: Large areas are known to be under private ownership.
Protection: None.
Land use: Fishing and hunting; agriculture in surrounding areas.
Waterfowl: An extremely important breeding area for Ciconiiformes, and a very important wintering area for ducks and coots, although much less so than thirty years ago. In 1971, Sprunt and Knoder estimated the total breeding population of Ciconiiformes at 20,000 pairs, in at least twelve colonies. Breeding censuses between 1973 and 1976 located up to 285 pairs of *Anhinga anhinga*, 2,950 pairs of *Bubulcus ibis*, 680 pairs of *Egretta tricolor*, 2,660 pairs of *Egretta thula*, 4,725 pairs of *Egretta alba*, 2,225 pairs of *Eudocimus albus*, 100 pairs of *Plegadis chihi* and 300 pairs of *Ajaia ajaja*. The average number of ducks observed in the midwinter counts from 1978 to 1982 was 72,800, compared with almost 250,000 in the 1950s. The commonest species have been *Dendrocygna bicolor, D. autumnalis, Anas crecca, A. strepera, A. americana, A. acuta, A. discors/cyanoptera, A. clypeata* and *Aythya affinis*. Other wintering ducks have included up to 585 *Anas (platyrhynchos) fulvigula*, 2,100 *Aythya valisineria*, and 4,880 *Oxyura jamaicensis*. Large numbers of geese occur in some winters, e.g. 7,990 *Anser albifrons* and 1,700 *Branta canadensis* in 1980, and an average of 103,000 *Fulica americana* have been recorded in recent years.
Other fauna: *Pandion haliaetus* occurs in winter.
Threats: Reduced flow in the Rio Tamesi as a result of impoundments and diversions upstream for irrigation has greatly reduced the extent of the marshes, and increased siltation as a result of soil erosion is adding to the problem. Pollution from oil and industrial waste is becoming serious at some lagoons. Laguna de Tamoa has been particularly badly affected, and most of the vegetation along the west side has died off.
References: Gehlbach *et al* (1976); Sprunt & Knoder (1980); Saunders & Saunders (1981); Norman (1979-1982).
Source: U.S. Fish & Wildlife Service and references.
Criteria for inclusion: 123.

Laguna de Tamiahua (29)

Location: 21°35'N, 97°30'W; 80 km SSE of Tampico, Veracruz.
Area: 105,000 ha.
Altitude: 0-1m.
Province and type: 8.1.1; 07 & 13.
Site description: A relatively narrow brackish lagoon with a sandy bottom, about 100 km long and mainly under 2.5m deep. The lagoon is fed by several streams, and opens into the Gulf of Mexico at Galindo Pass. The salinity is variable according to inflow, and at times is almost fresh. There are some small freshwater ponds and marshes adjacent to the lagoon.
Principal vegetation: No information.
Land tenure: No information.
Protection: None.
Land use: Fishing and hunting.

Waterfowl: A very important wintering area for ducks, geese and coots, although much less so than forty years ago. The average number of ducks observed in the midwinter counts from 1978 to 1982 was 71,000 ducks, compared with over 300,000 in the 1930s. The commonest species are *Anas strepera, A. americana, A. acuta, A. discors/cyanoptera, Aythya americana* (up to 17,400), *A. valisineria* (up to 4,900), *A. affinis* (up to 23,500) and *Oxyura jamaicensis* (up to 2,000). The numbers of geese vary considerably from year to year; peak counts in recent years have been 1,025 *Anser albifrons* and 3,000 *A. caerulescens.* 1,700,000 *Fulica americana* were recorded in 1939, but the average in recent years has been only 90,000.
Other fauna: Up to eight *Pandion haliaetus* have been recorded in winter.
Threats: Oil pollution from nearby oil fields has been a serious problem since the turn of the century. In 1909, the entire lagoon was covered in oil. Serious oil spills occurred in 1981 and 1982, threatening not only the waterfowl populations, but also the important local fishery. Other forms of industrial pollution and pollution from domestic waste are adding to the problem.
References: Saunders & Saunders (1981); Norman (1979-1982).
Source: U.S. Fish & Wildlife Service and references.
Criteria for inclusion: 1a & 1b.

Laguna Alvarado, Laguna Camaronera and the deltas of the Rio Papaloapan and Rio San Juan (30)

Location: 18°40'N, 95°45'W; 60 km southeast of Veracruz, Veracruz.
Area: c.250,000 ha of wetlands in a region of 538,000 ha.
Altitude: 0-40m.
Province and type: 8.1.1; 02, 07, 08, 09, 12 & 16.
Site description: A vast complex of mainly freshwater lagoons and marshes in the delta region of the Papaloapan and San Juan Rivers. Laguna Alvarado has a broad connection with the Gulf of Mexico at Boca de Alvarado, and is brackish with mangrove swamps. Laguna Camaronera is fresh. Marshes near the coast may be inundated with sea water during storms; and extensive areas of marsh and grassland along the main rivers are subject to seasonal flooding.
Principal vegetation: Mangrove swamps at Laguna Alvarado with *Avicennia germinans*; extensive beds of species of *Eichhornia, Nymphaea, Pistia, Azolla* and *Lemna*; marshes with species of *Eleocharis, Hydrocotyle, Heteranthera, Scirpus, Pontaderia, Polygonum, Sagittaria*, sedges and grasses.
Land tenure: Large portions are under private ownership.
Protection: None.
Land use: Fishing and hunting; agriculture, mainly for sugar cane and pineapples, in surrounding areas. The oil industry is well developed throughout the region.
Waterfowl: An important feeding area for Ciconiiformes, although there appear to be no large breeding colonies. In 1971, Sprunt and Knoder located only two small colonies with 930 pairs of *Egretta thula* and 25 pairs of *E. alba.* A very important wintering area for ducks and coots. The average midwinter counts for the period 1978 to 1982 were 104,400 ducks and 65,500 *Fulica americana.* The ducks were mainly *Dendrocygna bicolor, D. autumnalis, Anas americana, A. acuta, A. discors/cyanoptera, A. clypeata* and *Aythya affinis*, with up to 4,125 *Aythya valisineria*, 4,350 *A. collaris*, and 2,800 *Oxyura jamaicensis.*
Other fauna: Thirty-two *Pandion haliaetus* were observed during the midwinter census in 1980.
Threats: Dams on the major rivers have reduced the extent of flooding and also reduced the flushing out effect of the rivers, resulting in a greatly increased growth of floating aquatic vegetation and loss of open water. Large areas of wetland have been drained for agriculture and the drainage continues. There has been some oil pollution and pollution from industrial waste.
References: Sprunt & Knoder (1980); Saunders & Saunders (1981); Norman (1979-1982); Woodyard & Bolen (1984).
Source: U.S. Fish & Wildlife Service and references.
Criteria for inclusion: 1a & 3a.

Lago Catemaco (31)

Location: 18°25'N, 95°05'W; 15 km east of San Andres de Tuxtla, Veracruz.
Area: 8,500 ha.
Altitude: 335m.
Province and type: 8.1.1; 12.
Site description: A very deep freshwater lake with a narrow belt of fringing marshes; in the foothills.
Principal vegetation: Fringing marshes with some *Eichhornia* sp.
Land tenure: No information.
Protection: None.
Land use: Hunting; fishing; recreation, including water sports. Intensive agriculture in surrounding areas.
Waterfowl: Relatively unimportant for waterfowl, with few breeding birds and small numbers of wintering ducks, mainly *Aythya affinis* and *Oxyura jamaicensis*, and *Fulica americana.*
Other fauna: The lake supports a particularly large population of Morelet's Crocodile *Crocodylus moreletii*, estimated at about 200 in 1971.
Threats: No information.
References: WWF Red Data Book; Saunders & Saunders (1981).
Source: See references.
Criteria for inclusion: 2a & 3a.

Usumacinta Delta and Tabasco Lagoons (32)

Location: 17°45'-18°40'N, 94°05'-91°50'W; around the city of Villahermosa, Tabasco.
Area: c.1,000,000 ha of wetlands.
Altitude: 0-30m.
Province and type: 8.1.1; 02, 05, 07, 08, 09, 12 & 16.
Site description: A vast delta marshland system with a maze of distributary channels of the Rio Usumacinta, Rio Grijalva, Rio San Pedro, Rio San Pablo and Rio Palizada, and numerous freshwater lagoons, swamps and seasonally inundated marshes. Along the coast there are tidal saline lagoons and beach ridges supporting semideciduous forest backed by extensive brackish lagoons and mangrove swamps. Inland, gallery forest along the rivers grades into the forests of the Chiapas highlands.
Principal vegetation: The main habitats are: (1) beach communities with *Sesuvium portulacastrum*; (2) mangrove forests with *Avicennia germinans, Laguncularia racemosa* and *Rhizophora mangle*; (3) thickets of *Conocarpus erectus* and *Hibiscus* sp; (4) shrub marsh with *Conocarpus erectus, Laguncularia racemosa, Hibiscus sp, Acrostichum* sp and *Annona glabra*, (5) grass, sedge and forb marshes with *Typha latifolia, Thalia geniculata, Sagittaria sp, Echinodorus sp, Cyperus spp, Cladium sp, Phragmites communis* and *Panicum* sp; (6) lakes and ponds with *Pistia stratiotes, Eichhornia crassipes*, grasses and sedges; (7) brackish lagoons with *Thalassia testudinum*; (8) savannas with scattered palms *Acrocomia mexicana* and *Brahea dulcis*; and (9) gallery forest along streams and channels.
Land tenure: Mixed, with large areas under private ownership.
Protection: None.
Land use: There is an important shrimp fishery, some other fishing, and hunting. Other activities include a little forest exploitation, agriculture and livestock grazing, but large parts of the delta are still relatively undisturbed.
Waterfowl: An extremely important breeding, passage and wintering area for a wide variety of waterfowl. In May 1977, Sprunt and Knoder estimated the total population of Ciconiiformes in the delta at 250,000, and located 50,000 breeding pairs in five major colonies. This constitutes the largest concentration of Ciconiiformes in Mexico. Censuses in 1971 and 1972 included up to 750 pairs of *Phalacrocorax olivaceus*, 3,140 *Bubulcus ibis*, 30,000 *Egretta thula*, 27,000 *E. alba*, 525 pairs of *Ardea herodias*, 15,000 pairs of *Mycteria americana*, 1,250 pairs of *Eudocimus albus* and 1,250 pairs of *Ajaia ajaja.* Counts of other common breeding species have included up to 500 *Plegadis chihi*, 47,000 *Dendrocygna autumnalis*, 1,500 *Aramus guarauna* and 2,950 *Jacana spinosa.* Breeding species occurring in much smaller numbers

include *Pelecanus occidentalis, Anhinga anhinga, Tigrisoma mexicanum, Cochlearius cochlearius, Agamia agami, Jabiru mycteria* (up to 47 birds recorded) and *Himantopus himantopus.* Midwinter censuses in recent years have included up to 2,430 *Pelecanus occidentalis* and an average of 245,000 ducks and 40,350 *Fulica americana.* The most abundant ducks have been *Dendrocygna bicolor, D. autumnalis, Anas americana, A. acuta, A. discors/cyanoptera, A. clypeata, Aythya affinis* and *A. collaris*; other species have included *Bucephala albeola* (up to 400) and *Oxyura jamaicensis* (up to 860).

Other fauna: There is a high diversity and abundance of birds of prey including a large breeding population of *Rostrhamus sociabilis*, and wintering populations of *Pandion haliaetus* and *Falco peregrinus.* The manatee *Trichechus manatus* and Jaguar *Leo onca* still occur in the delta. Reptiles include *Crocodylus moreletii*, the freshwater turtles *Chelydra serpentina* and *Kinosternon leucostomum*, and the sea turtles *Eretmochelys imbricata* and *Chelonia mydas.* The nutrient laden waters of the rivers support major fisheries in inshore waters, and the important local shrimp fishery is dependent on the delta lagoons which function as a nursery ground for juvenile shrimps.

Threats: Huge oil fields have been discovered beneath the region; development of these could cause tremendous ecological damage. Serious oil pollution has already occurred, particularly around Minatitlan and the Coatzacoalcos industrial complex, and most rivers and lagoons have been affected. The mangroves are being exploited for timber, and drainage for agriculture could pose a serious threat in the future. There is also a considerable amount of disturbance from fishing and other human activities in the region.

Research and conservation: A number of surveys of breeding and wintering waterfowl have been conducted by the U.S. National Audubon Society and U.S. Fish and Wildlife Service, and Duever and Sprunt have recently proposed that a detailed ecosystem analysis be conducted in the delta. It is essential that the development of the oil fields be skillfully integrated with the ecological processes of the wetlands if the valuable fisheries and wildlife resources are to be maintained.

References: Duever & Sprunt (1978); Sprunt & Knoder (1980); Saunders & Saunders (1981); Norman (1979-1982).

Source: U.S. Fish & Wildlife Service and references.

Criteria for inclusion: 123.

Laguna de Terminos (33)

Location: 18°35'N, 91°35'W; south and east of Ciudad del Carmen, Campeche.

Area: 300,000 ha.

Altitude: 0m.

Province and type: 8.1.1; 05, 07, 09, 12 & 18.

Site description: A large brackish coastal lagoon, mainly under 1m deep, connected with the Gulf of Mexico by broad channels at each end of the low barrier island, Isla del Carmen. The largest rivers entering the lagoon are the Palizada, Champan and Candelaria. Forest extends to the water's edge along much of the southwest shore; elsewhere there are muddy shores and grassy marshes. There are large areas of freshwater lakes, marshes and swamp forest to the west of the lagoon.

Principal vegetation: Extensive beds of *Ruppia* sp in the lagoon; grassy marshes; and swamp forest.

Land tenure: No information.

Protection: None.

Land use: Fishing and hunting.

Waterfowl: A very important breeding, passage and wintering area for a wide variety of waterfowl, with almost the same species as the Usumacinta Delta (site 32). The most important area in Mexico for the Jabiru *Jabiru mycteria.* Most surveys in the 1970s found between 10 and 20 birds, and no more than three nests were located in any one year, but in May 1978, 83 adults and 6 juveniles were observed.

Other fauna: The sea turtles *Eretmochelys imbricata* and *Chelonia mydas* neston the beaches of the barrier island.

Threats: There is a high population density in the area, and general urban expansion and development of agriculture threaten the wetland habitat. The fisheries are being overexploited, and there has been some oil pollution in the lagoon.
References: Knoder *et al* (1980); Saunders & Saunders (1981).
Source: See references.
Criteria for inclusion: 1a, 1b & 3a.

Coastal marshes north of Campeche (34)

Location: 20°00'-20°40'N, 90°25'W; along the coast 20-100 km north of Campeche, Campeche.
Area: c.120,000 ha.
Altitude: 0m.
Province and type: 8.1.1; 06, 07 & 08.
Site description: A broad coastal belt of salt flats with halophytic communities, saline lagoons, fringing mangroves, intertidal mudflats, and series of canals perhaps dating back to Mayan times. Large tracts of the mangroves were devastated in hurricanes in the early 1930s.
Principal vegetation: Mangrove swamps; beds of *Ruppia* sp in the lagoons; offshore beds of *Diplanthera* sp and associated marine grasses.
Land tenure: No information.
Protection: None.
Land use: No information.
Waterfowl: An important feeding area for large numbers of Ardeidae (including *Egretta rufescens*), *Eudocimus albus* and *Phoenicopterus ruber*, but no large breeding colonieshave as yet been located. An important passage and wintering area for *Pelecanus occidentalis*, Anatidae, *Fulica americana* and shorebirds. The most abundant ducks are *Anas americana, A. acuta, A. discors/cyanoptera, A. clypeata, Aythya affinis* and *A. collaris.*
Other fauna: No information.
Threats: There is a potential threat of oil pollution from the developing petroleum industry around Campeche city.
References: Saunders & Saunders (1981); Norman (1979-1982).
Source: U.S. Fish & Wildlife Service and references.
Criteria for inclusion: 1a & 3a.

Ria de Celestun (35)

Location: 20°55'N, 90°23'W; 75 km west of Merida, Yucatan.
Area: 60,000 ha.
Altitude: 0-2m.
Province and type: 8.1.1/8.15.4; 07 & 08.
Site description: A chain of narrow brackish to highly saline coastal lagoons, up to 2m deep, with salinities varying according to the inflow of freshwater. Some of the lagoons have fringing mangrove swamps; others have muddy shores with adjacent salt flats and halophytic vegetation. Approximately 40,000 ha are permanently flooded; the remaining 20,000 ha are flooded for about six months of the year.
Principal vegetation: Mangrove swamps with *Avicennia germinans, Laguncularia racemosa* and *Rhizophora mangle*; beds of *Ruppia* sp and some *Chara* sp in the lagoons; halophytic vegetation including *Batis maritima, Salicornia* sp and *Monanthochloe* sp.
Land tenure: A mixture of state, local government and private ownership.
Protection: Largely protected within a Faunal Refuge (59,130 ha) established in 1979. Hunting is prohibited in the refuge.
Land use: Fishing, hunting and tourist recreation.
Waterfowl: A very important breeding, passage and wintering area for a wide variety of waterfowl. Breeding birds include up to 600 pairs of *Phalacrocorax olivaceus* and 300 pairs

of *Dendrocygna autumnalis.* Other species present year round include *Pelecanus occidentalis Anhinga anhinga, Ixobrychus exilis, Nycticorax nycticorax, Nyctanassa violacea, Cochlearius cochlearius, Egretta caerulea, E. tricolor, E. thula, E. alba, Ardea herodias, Mycteria americana, Eudocimus albus, Ajaia ajaja, Cairina moschata, Aramides axillaris, Haematopus palliatus, Himantopus himantopus* and *Sterna albifrons.* The lagoons constitute important feeding habitat for 5,000 to 10,000 Caribbean Flamingos *Phoenicopterus ruber* from the breeding colony at Rio Lagartos (site 37). Up to 100,000 Anatidae and 100,000 *Fulica americana* have been recorded in winter, and large numbers of shorebirds and Laridae occur on migration and in winter. Seventeen species of Anatidae have been observed, the most abundant being *Anas acuta, A. discors* and *Aythya affinis.*

Other fauna: *Pandion haliaetus* is a regular winter visitor. Reptiles include *Crocodylus moreletii* and *Boa constrictor.*

Threats: There is a potential threat of oil pollution from the developing petroleum industry in Campeche; the fisheries resources are being overexploited; and there is some disturbance from tourist recreation.

Research and conservation: A variety of faunal and floral studies have been conducted in the refuge. Ducks Unlimited Mexico (DUMAC) has been involved in a wetland management project to halt ecological deterioration of the flamingo wintering areas, and an Ecological Investigation Centre is to be built.

References: Hernandez & Vargas (1976); Saunders & Saunders (1981).

Source: Antonio Rogel Bahena and Arturo Lopez Ornat.

Criteria for inclusion: 1a, 1b & 3a.

Dzilam de Bravo Lagoons (36)

Location: 21°25'N, 88°40'W; 90 km east of Progreso, Yucatan.

Area: c.6,500 ha.

Altitude: 0m.

Province and type: 8.15.4; 05, 07 & 08.

Site description: A complex of brackish to saline coastal lagoons and mangrove swamps separated from the sea by a sand barrier; subject to periodic drying out.

Principal vegetation: Mangrove swamps and halophytic vegetation.

Land tenure: No information.

Protection: None.

Land use: No information.

Waterfowl: Little information available; but known to be an important wintering area for *Pelecanus erythrorhynchos, P. occidentalis, Phoenicopterus ruber, Anas discors* and huge numbers of shorebirds.

Other fauna: No information.

Threats: There are no immediate threats to the area, but the town of Progreso to the west is developing as an important sea port, and disturbance along the coast is likely to increase.

Source: U.S. Fish & Wildlife Service.

Criteria for inclusion: 1a.

Rio Lagartos (37)

Location: 21°30'N, 87°34'-88°18'W; 50 km north of Tizimin, Yucatan.

Area: 48,000 ha.

Altitude: 0-5m.

Province and type: 8.15.4; 02, 05, 07 & 08.

Site description: A series of small estuaries and saline coastal lagoons, up to 2m deep, with fringing mangrove swamps. The lagoons are separated from the sea by a sand barrier and are flooded at high tides; there is some inflow of fresh water from seepage and local rainfall. Salinities range from 33 p.p.t. to 107 p.p.t. About 30,000 ha are permanently flooded; the remaining 18,000 ha dry out during the dry season.

Principal vegetation: Mangrove swamps with *Avicennia germinans, Laguncularia racemosa,* and *Rhizophora mangle*; sand dune and halophytic vegetation.

Land tenure: A mixture of state, local government and private ownership.

Protection: Included within a Faunal Refuge of 47,480 ha, established in 1979 to protect flamingo nesting habitat.

Land use: Fishing, industrial salt extraction and tourist recreation.

Waterfowl: The only regular breeding site for the Yucatan population of the Caribbean Flamingo *Phoenicopterus ruber.* This population increased from an estimated 8,000 birds in 1975 to 26,000 in 1981, and is probably still increasing. The breeding population at Rio Lagartos numbered at least 4,250 pairs in 1982, and was thought to be about 5,000 pairs in 1984. Other breeding birds include 150 pairs of *Phalacrocorax olivaceus* and large numbers of *Larus atricilla* and *Sterna maxima.* The area is also an important feeding area for *Pelecanus occidentalis*, a wide variety of Ardeidae, *Mycteria americana, Eudocimus albus, Ajaia ajaja* and many passage and wintering shorebirds and Laridae. Relatively few Anatidae winter in the area; the only species present in significant numbers are *Dendrocygna autumnalis, Anas americana, A. acuta, A. discors* and *Aythya affinis.*

Other fauna: Morelet's Crocodile *Crocodylus moreletii* and the sea turtles *Lepidochelys olivacea* and *Dermochelys coriacea* occur in the area.

Threats: Disturbance from tourists, particularly in power boats, has caused problems at the flamingo colony, and further development of facilities for tourist recreation in the area is likely to increase the problem in the future. In addition, flamingo feeding and nesting habitat is being destroyed for salt extraction.

Research and conservation: Basic faunal and floral surveys have been conducted in the refuge, and Rogel has been studying the flamingo population for some years. Experiments are now being carried out with the creation of artificial nest sites for the flamingos, which would not be subject to flooding.

References: Hernandez & Vargas (1976); Mondragon (1979); Saunders & Saunders (1981); Rogel (1983 & in press).

Source: Antonio Rogel Bahena and Arturo Lopez Ornat.

Criteria for inclusion: 1c, 2a & 3a.

Holbox Lagoons (38)

Location: 21°30'N, 87°20'W; 80 km ENE of Tizimin, Yucatan.

Area: 70,000 ha.

Altitude: 0m.

Province and type: 8.15.4; 02, 07 & 08.

Site description: An estuarine system with associated shallow brackish lagoons, mangrove swamps and salt flats.

Principal vegetation: Mangrove swamps and halophytic vegetation.

Land tenure: No information.

Protection: None.

Land use: No information.

Waterfowl: An important feeding area for hundreds of *Pelecanus occidentalis*, up to 1,500 *Phoenicopterus ruber* and large numbers of passage and wintering shorebirds and Laridae. Several hundred *Pelecanus erythrorhynchos* and small numbers of *Anas discors* occur in winter.

Other fauna: No information.

Threats: There is a potential threat from coastal development for tourism and recreation.

Source: Arturo Lopez Ornat.

Criteria for inclusion: 1b & 3a.

Isla Contoy (39)

Location: 21°30'N, 86°49'W; 40 km north of Puerto Juarez, 10 km off the northeast tip of Yucatan.
Area: 700 ha.
Altitude: 0-5m.
Province and type: 8.15.4; 03, 06 & 08.
Site description: A low offshore island with surrounding mangrove swamps and intertidal mudflats.
Principal vegetation: Mangrove swamps.
Land tenure: No information.
Protection: Included within an Ecological Reserve established in 1971.
Land use: Fishing and tourism.
Waterfowl: An important breeding area for *Pelecanus occidentalis* (up to 600 pairs), *Phalacrocorax olivaceus* (thousands of pairs), *Egretta caerulea, E. tricolor, E. rufescens* (100 pairs), *E. thula, E. alba, Ardea herodias* and *Ajaia ajaja.* Large numbers of Nearctic shorebirds and Laridae occur on passage and in winter, and *Pelecanus erythrorhynchos* occurs in small numbers.
Other fauna: There is a large breeding colony of sea-birds, including thousands of pairs of *Fregata magnificens*, hundreds of pairs of *Sula leucogaster* and 100 pairs of *Sterna anaethetus.*
Threats: There is a considerable amount of disturbance from tourism.
References: Sprunt & Knoder (1980).
Source: Arturo Lopez Ornat.
Criteria for inclusion: 1c, 2c & 3a.

Bahia de La Ascension and Bahia del Espiritu Santo (Sianka'an) (40)

Location: 19°05'-20°06'N, 87°25'-88°00'W; 70-200 km NNE of Chetumal, Quintana Roo.
Area: 335,000 ha of bays and marshes in a total area of 450,000 ha.
Altitude: 0-10m.
Province and type: 8.1.1; 01, 03, 05, 07, 08, 09, 12 & 16.
Site description: Two large shallow sea bays with numerous mangrove covered islands and extensive fringing mangrove swamps; coastal dunes; and a vast area of fresh to brackish lagoons, swamps and seasonally flooded marshes and savannas inland. The 180,000 ha of seasonally flooded plains are inundated for five months of the year, from December to April. Salinities in the marshes vary greatly, from 0-12 p.p.t. in the wet season to 10-20 p.p.t. in the dry. There are many pools in limestone sinkholes (cenotes) with subterranean connection with the sea.
Principal vegetation: Mangrove swamps with *Avicennia germinans, Conocarpus erectus, Laguncularia racemosa* and *Rhizophora mangle*; coastal dune vegetation; fresh to brackish marshes; seasonally flooded savanna; and *Acacia* scrub. In a region of tropical subevergreen and deciduous forest (Mediana forest).
Land tenure: State owned.
Protection: The Government of Quintana Roo is currently implementing a proposal for the establishment of a Biosphere Reserve of 400,000 ha.
Land use: Fishing, some agriculture and a little tourism. Much of the area is almost totally undisturbed.
Waterfowl: An extremely important breeding, passage and wintering area for a wide variety of waterfowl, although of very little importance for wintering Anatidae. Breeding birds include up to 500 pairs of *Pelecanus occidentalis*, 4,000 pairs of *Phalacrocorax olivaceus*, 1,000-1,500 pairs of *Mycteria americana*, 1,000-1,500 pairs of *Eudocimus albus*, and 300-500 pairs of *Ajaia ajaja.* Other breeding species include *Anhinga anhinga, Nyctanassa violacea, Cochlearius cochlearius, Egretta rufescens, Ardea herodias, Aramides cajanea* and *Jacana spinosa. Botaurus pinnatus, Agamia agami* and *Jabiru mycteria* occur in small numbers and may breed. *Phoenicopterus ruber* occurs in Bahia de La Ascension as a non-breeding visitor.

Common Nearctic migrants include *Anas discors*, *Charadrius semipalmatus*, *Pluvialis squatarola*, *Catoptrophorus semipalmatus*, *Actitis macularia*, *Arenaria interpres*, *Calidris alba* and *C. pusilla*.

Other fauna: The Osprey *Pandion haliaetus* is a fairly common breeding bird and winter visitor. The rich mammalian fauna includes *Tapirus bairdii* and *Trichechus manatus*. Morelet's Crocodile *Crocodylus moreletii* is fairly common, and the rare mud turtle *Kinosternon creaseri* presumably occurs.

Threats: There is some disturbance from tourism.

Research and conservation: Preliminary faunal and floral surveys are being conducted in the area. There are at present few protected areas in southeast Mexico, and this area, with its very rich fauna and flora, is especially worthy of conservation.

References: Saunders & Saunders (1981); CIQRO & Instituto de Biologia (1982); Lopez Ornat (in press).

Source: Antonio Rogel Bahena and Arturo Lopez Ornat.

Criteria for inclusion: 123.

Wetlands in Nearctic Mexico

Most of Baja California, the northern Gulf Coast and all the interior highlands of Mexico except for the Chapala basin are generally considered as lying within the Nearctic Realm, and are thus outside the scope of this Directory. However, for the sake of completeness, the twenty-five wetlands which have been identified as of special importance in these regions are listed below.

Rio Grande Delta, Tamaulipas: 25°50'N, 97°10'W. Unprotected. Important for wintering ducks, geese and *Fulica americana*.

Laguna Madre, Tamaulipas: 25°00'N, 97°35'W. Unprotected. Extremely important for wintering ducks, geese and *Fulica americana*, and breeding Ardeidae and *Pelecanus erythrorhynchos*.

Bahia San Quintin, Baja California: 30°25'N, 115°59'W. Unprotected. Important for wintering *Branta bernicla*.

Laguna Ojo de Liebre (Scammon's Lagoon), Baja California: 27°50'N, 114°15'W. Partly protected in a Marine Refuge of 40,000 ha established in 1978. Important for breeding and wintering Ardeidae, wintering *Branta bernicla*, and Grey Whales *Eschrichtius gibbosus*.

Bahia and Laguna San Ignacio, Baja California: 26°50'N, 113°11'W. Protected in a Sanctuary. Important for breeding Ardeidae, wintering *Pelecanus occidentalis*, Ardeidae and *Branta bernicla*, and Grey Whales *Eschrichtius gibbosus*.

Bahia Magdalena and Bahia Almejas, Baja California: 24°45'N, 112°00'W. Unprotected. Important for wintering *Pelecanus occidentalis* and *Branta bernicla*, and Grey Whales *Eschrichtius gibbosus*.

Rio Colorado Delta, Baja California and Sonora: 31°45'N, 114°45'W. Unprotected. Important for wintering ducks and geese.

Laguna Salada, Baja California: 32°20'N, 115°20'W. Unprotected. Important for wintering *Pelecanus erythrorhynchos*.

Laguna de Bavicora, Chihuahua: 29°20'N, 107°50'W. Unprotected. Important for breeding Ardeidae, and wintering ducks, geese, *Grus canadensis* and shorebirds.

Laguna de Encinillas, Chihuahua: 29°18'N, 106°17'W. Unprotected. Important for breeding Ardeidae.

Laguna de Los Bustillos, Chihuahua: 28°33'N, 106°45'W. Unprotected. Important for breeding Ardeidae, and wintering geese and shorebirds.

Laguna de Los Mexicanos, Chihuahua: 28°10'N, 106°57'W. Unprotected. Important for breeding Ardeidae, and wintering geese and *Grus canadensis*.

Lago Toronto (Presa de La Boquilla), Chihuahua: 27°31'N, 105°30'W. Unprotected. Important for breeding Ardeidae.

Cuatro Cienagas de Carranza, Coahuila: 26°59'N, 102°04'W. Unprotected. A unique intermontane desert ecosystem with a high number of endemic turtles, fishes and snails.

Presa El Palmito (Rio de Oro), Durango: 25°35'N, 105°02'W. Unprotected. Important for breeding Ardeidae, and wintering geese.

Laguna de Santiaguillo, Durango: 24°55'N, 104°53'W. Unprotected. Important for breeding Ardeidae, and wintering ducks and geese.

Irapuato Reservoirs, Guanajuato: 20°47'N, 101°30'W. Unprotected. Important for wintering ducks.

Laguna de Yuriria, Guanajuato: 20°15'N, 101°08'W. Unprotected. Important for wintering ducks.

Laguna Cuitzeo, Michoacan: 19°55'N, 101°05'W. Unprotected. Important for breeding Ardeidae, and wintering ducks and *Fulica americana*.

Lagunas de Zacapu, Michoacan: 19°54'N, 101°40'W. Unprotected. Important for wintering ducks.

Lago de Patzcuaro, Michoacan: 19°35'N, 101°40'W. Unprotected. The only known locality for the endangered salamander *Ambystoma dumerili dumerili*; formerly important for wintering ducks, but only a few thousands have been recorded in the 1980s.

The upper Rio Lerma, Estado de Mexico: 19°10'N, 99°32'W. Unprotected. The only known locality for the endangered salamander *Ambystoma lermaensis*; formerly important for wintering ducks, but only a few thousands have been recorded in the 1980s.

Lago de Texcoco, Distrito Federal: 19°30'N, 99°00'W. Unprotected. Important for wintering ducks and passage shorebirds, but now almost completely destroyed.

Lago Xochimilco, Distrito Federal: 19°15'N, 99°02'W. Unprotected. The only known locality for the endangered Axolotl *Ambystoma mexicanum*.

Laguna Oriental (El Carmen), Puebla: 19°18'N, 97°37'W. Unprotected. Important for wintering ducks.

References: Minckley (1969 & ?); Contreras-Balderas (1976); Knoder *et al* (1980); Sprunt & Knoder (1980); Saunders & Saunders (1981); Norman (1979-1982); Babb *et al* (1983); Conant & Novara (1983); Conant & Voelzer (1984); Almada Villela & Contreras Balderas (in press); WWF Red Data Book.

Islands in the Gulf of California, although of little importance for true waterfowl, are very important for a variety of sea-birds, *Pelecanus occidentalis* and *Pandion haliaetus*. The islands and their fauna have recently been described in some detail by Mendoza (1975), Anderson & Anderson (1976), Anderson *et al* (1976), Henny & Anderson (1979), Anderson & Keith (1980), Anderson (1983) and Case & Cody (1983). The Islas del Golfo de California Reserve (340,000 ha) established in 1978 includes many of the islands.

NICARAGUA

INTRODUCTION

by **Milton Camacho**

Nicaragua has a surface area of 130,000 km^2, with 541 km of coastline on the Caribbean and 352 km on the Pacific. The population density is low, the total population being about three million.

Three well-defined regions can be distinguished; the central mountainous zone, the river valleys and alluvial plain of the Caribbean lowlands in the east, and the southern coastal plain, approximately 65-80 km wide, extending from the Golfo de Fonseca on the Pacific coast in the west to Lake Nicaragua in the east. This southern zone includes two vast wetlands, Lake Managua and Lake Nicaragua, with sandy shores, extensive permanent marshes and adjacent seasonally flooded marshes.

Institutional Base for Wetland Conservation and Research

The Instituto Nicaraguense de Recursos Naturales y del Ambiente (IRENA) is the governmental organization responsible for conservation and wildlife research in Nicaragua; active programmes are pursued by its Departamento de Fauna. There are no other organizations dedicated to these activities at the present time.

Progress in Wetland Conservation and Research

Wetlands have not as yet been the subject of special study in Nicaragua, and no special conservation measures have been applied except for the protection by official decree of 58,988 ha of wetlands in September 1983. These wetlands include marshes, swamps and small lakes in the interior and southwest of the country, but the protection is inefficient because of technical and economic limitations. None of the numerous and extensive wetlands of the Caribbean watershed are included in the protected areas. The protected wetlands are included within the following Nature Reserves:

Maribio volcanoes
    Cosiguina, 12,420 ha.
    San Cristobal, 17,950 ha.
    Telica-Orota, 9,088 ha.
    Pilas, 7,422 ha.
    Momotombo, 8,500 ha.
    Chiltepe, 1,800 ha.
Pacific wetlands
    Estero Real, 38,725 ha.
    Estero Padre Ramos, 7,815 ha.
    Estero Juan Venado, 5,763 ha.
Wildlife areas in the southwest
    Volcan Masaya, 5,400 ha.
    Volcan Mombacho, 600 ha.
    Lagunas de Mecatepe, 2,247 ha.
    Laguna de Tisma, 4,438 ha.
    Archipielago Zapatera, 5,226 ha.
    Chacocente, 4,800 ha.
    Volcanes de Ometepe, 1,630 ha.

Nicaragua

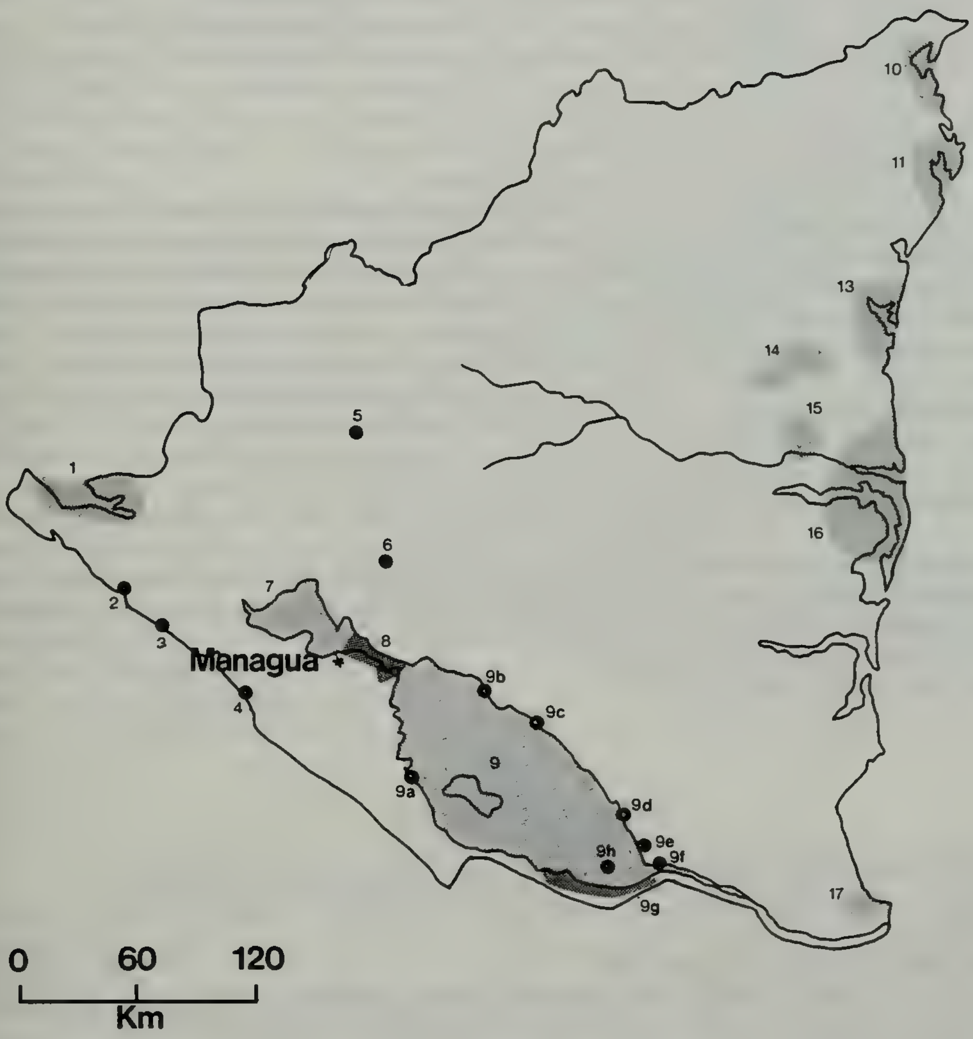
Of the research programmes currently being carried out in Nicaragua, only one is especially concerned with wetlands and waterfowl, namely a study of the Jabiru *Jabiru mycteria.*

In November 1983, a banding programme for migratory birds including waterfowl was initiated by IRENA in collaboration with the Bird Banding Laboratory at Laurel, Maryland, U.S.A.

Major Threats to Wetlands and Waterfowl

The principal threats to wetlands and their avifauna in Nicaragua are pollution with pesticides used in agriculture, and drainage and diversion of water courses for agriculture and ranching. Hunting does not constitute a threat to waterfowl populations, as there is very little hunting pressure because of firearms controls.

NICARAGUA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WETLANDS

Site descriptions based on data sheets provided by Milton Camacho, M. Fonseca, E. Gomez and Janet Sandino of the Instituto Nicaraguense de Recursos Naturales y del Ambiente (IRENA), assisted by R. Cisneros, Jose V. Morales, Octavio Saldana and Marisol Sanchez.

Estero Real (1)

Location: 12°47'-13°00'N, 87°00'-87°30'W; 25 km north of Chinandega, Chinandega Department.
Area: 68,380 ha.
Altitude: 0-13m.
Province and type: 8.16.4; 02, 06 & 08.
Site description: A large estuarine system, part of the Golfo de Fonseca, with extensive intertidal sand flats and mudflats, and mangrove swamps. The largest area of mangroves on the Pacific coast of Nicaragua. (See Honduras site 5 and El Salvador site 8.)
Principal vegetation: Mangrove swamps with *Avicennia tomentosa, Conocarpus erectus, Laguncularia racemosa* and *Rhizophora mangle*; in a region of dry tropical forest and humid subtropical forest.
Land tenure: State owned.
Protection: Protected within a Nature Reserve established in 1983.
Land use: Cutting of mangroves, and fishing for shrimps.
Waterfowl: A very rich area for both breeding and non-breeding waterfowl of a wide variety of species. Common breeding species recorded in hundreds or thousands include *Pelecanus occidentalis, Nycticorax nycticorax, Cochlearius cochlearius, Egretta thula, Mycteria americana, Eudocimus albus, Ajaia ajaja, Dendrocygna autumnalis* and *Cairina moschata.* Other resident species include *Nyctanassa violacea, Amaurolimnas concolor* and *Aramides cajanea. Jabiru mycteria* has been reported. Common Nearctic migrants include *Ardea herodias, Anas discors, A. clypeata, Aythya affinis*, a variety of shorebirds (particularly *Numenius phaeopus, Catoptrophorus semipalmatus* and *Actitis macularia*), and *Larus atricilla.*
Other fauna: The Osprey *Pandion haliaetus* occurs as a non-breeding visitor. *Leo onca, Canis latrans* and *Crocodylus acutus* occur.
Threats: There is increasing destruction of mangroves, and there are some problems from pollution.
Research and conservation: The area has been studied in some detail as part of a wider project for the evaluation of natural areas in the Pacific Region of Nicaragua (Catastro and IRENA).
References: Catastro & IRENA (1977); Dilger (1983).
Source: Milton Camacho and Janet Sandino.
Criteria for inclusion: 2b, 2c & 3a.

Estero Doña Paula (2)

Location: 12°25'N, 87°07'W; 20 km south of Chinandega, Chinandega Department.
Area: 3,088 ha.
Altitude: 0-25m.
Province and type: 8.16.4; 02, 03, 06 & 08.
Site description: A small estuary with numerous islets, extensive mudflats and mangrove swamps.
Principal vegetation: Mangrove swamps with *Avicennia germinans* and *Rhizophora mangle.*
Land tenure: State owned.
Protection: None.
Land use: Fishing, and wood-cutting.

Waterfowl: An important breeding area, with large numbers of nesting *Butorides virescens*, *Egretta caerulea* and *Dendrocygna autumnalis*, and smaller numbers of *Egretta tricolor*, *E. alba* and *Mycteria americana*. Thousands of *Pelecanus occidentalis* occur as non-breeding visitors, and large numbers of *Anas discors*, Nearctic shorebirds and *Larus atricilla* occur on migration and in winter.
Other fauna: An important estuary for the reproduction of many fishes and crustaceans.
Threats: The principal threats are pollution from agricultural run-off, deforestation, and disturbance from motor-boats.
Source: M. Fonseca.
Criteria for inclusion: 2c & 3a.

Isla del Venado (3)

Location: 12°17'N, 86°55'W; 15 km southwest of Leon, Leon Department.
Area: 3,450 ha.
Altitude: 0-25m.
Province and type: 8.16.4; 02, 05, 06 & 08.
Site description: A complex of mangrove swamps, tidal mudflats and long sandy beaches around an island in the estuarine system of the Rio La Barra and Rio La Garita.
Principal vegetation: Mangrove swamps; in the dry tropical forest zone.
Land tenure: State owned.
Protection: None.
Land use: The cutting of mangroves, and recreation.
Waterfowl: Very important both as a breeding area and wintering area for waterfowl. Common breeding species include *Nycticorax nycticorax*, *Cochlearius cochlearius*, *Egretta caerulea*, *E. thula*, *Mycteria americana*, *Eudocimus albus*, *Ajaia ajaja*, *Dendrocygna autumnalis*, *Cairina moschata*, *Aramus guarauna*, *Amaurolimnas concolor*, *Aramides cajanea* and *Jacana spinosa*. *Jabiru mycteria* is also reported to breed. Common migrants include *Ardea herodias*, *Anas discors*, *A. clypeata*, *Fulica americana*, a wide variety of Nearctic shorebirds (particularly *Charadrius semipalmatus*, *Actitis macularia* and *Calidris minutilla*), and *Larus atricilla*.
Other fauna: Sea turtles nest on the beaches, and *Crocodylus acutus* occurs.
Threats: The stretch of water between the island and the mainland is being cleared and dredged to facilitate navigation, and the mangroves are being cut.
Research and conservation: Preliminary faunal and floral surveys have been conducted by IRENA, and it has been proposed that the area be considered for the establishment of a wildlife refuge (Refugio de Vida Silvestre).
References: Catastro & IRENA (1977).
Source: M. Fonseca and Janet Sandino.
Criteria for inclusion: 2c & 3a.

Charco de Salamino (4)

Location: 11°57'N, 86°38'W; 45 km WSW of Managua, Managua Department.
Area: 250 ha.
Altitude: 0-10m.
Province and type: 8.16.4; 05 & 07.
Site description: A brackish coastal lagoon, up to 6m deep, with a muddy shoreline; separated from the sea by a sand barrier.
Principal vegetation: Brackish marshes with species of *Pistia* and Gramineae.
Land tenure: State owned.
Protection: None.
Land use: Extraction of salt; cattle ranching, agriculture and wood-cutting in surrounding areas.
Waterfowl: An important area for both breeding and wintering waterfowl. Common breeding species include *Pelecanus occidentalis*, *Anhinga anhinga*, *Egretta caerulea*, *Mycteria americana*, *Dendrocygna autumnalis*, *Cairina moschata* and various Rallidae. Common Nearctic migrants

include *Anas discors*, a variety of shorebirds, and *Chlidonias nigra*.
Other fauna: Mammals occurring in the area include *Didelphis marsupialis*, *Nasua narica* and *Procyon lotor*.
Threats: Construction of ponds for the extraction of salt; overgrazing in the marshes; and expansion of agriculture in surrounding areas. According to the local inhabitants, bird populations have decreased considerably in recent years.
Source: M. Fonseca.
Criteria for inclusion: 3a.

Lago de Apanas (5)

Location: 13°10'N, 85°58'W; 7 km north of Jinotega, Jinotega Department.
Area: 9,405 ha.
Altitude: 1,050m.
Province and type: 8.16.4; 15.
Site description: A man-made lake with extensive marshes and muddy shoreline.
Principal vegetation: The aquatic vegetation includes *Eichhornia crassipes*, *Typha latifolia*, *Panicum purpurascens*, *Najas guadalupensis*, *Caperonia palustris* and species of *Jussiaea* and *Polygonum*. The surrounding areas have been deforested.
Land tenure: State owned.
Protection: None.
Land use: Fishing; agriculture and cattle ranching in surrounding areas.
Waterfowl: An important area for both breeding and wintering waterfowl. Common breeding species include *Podilymbus podiceps*, *Phalacrocorax olivaceus*, *Ixobrychus exilis*, *Nycticorax nycticorax*, *Nyctanassa violacea*, *Egretta caerulea*, *Dendrocygna autumnalis*, *Aramides cajanea*, *Porphyrula martinica*, *Jacana spinosa* and *Himantopus himantopus*. Common winter visitors include *Anas acuta*, *A. discors*, *A. cyanoptera*, *A. clypeata*, *Fulica americana*, *Tringa solitaria*, *Actitis macularia* and *Larus atricilla*.
Other fauna: The Central American Otter *Lutra anectens* occurs.
Threats: There is pollution from agricultural run-off and domestic sewage.
Research and conservation: Basic faunal and floral studies have been conducted by IRENA.
References: Catastro & IRENA (1973); IRENA (undated).
Source: Milton Camacho and Janet Sandino.
Criteria for inclusion: 2b & 3a.

Lago de Moyua, Lago Tecomapa and Lago Las Playitas (6)

Location: 12°35'N, 86°04'W; 55 km NNE of Managua, Matagalpa Department.
Area: 888 ha.
Altitude: 420m.
Province and type: 8.16.4; 12.
Site description: Three shallow freshwater lakes and associated marshes, subject to wide fluctuations in water level. At high water levels the lakes discharge into the Rio Grande de Matagalpa; the two smaller lakes, Tecomapa and Las Playitas, dry out in the dry season.
Principal vegetation: The aquatic vegetation includes *Eichhornia crassipes* and *Pistia* sp; in a region of dry thorn scrub with species of *Prosopis*.
Land tenure: Lago de Moyua is state owned; the other lakes are privately owned.
Protection: The hunting of birds is prohibited at all three lakes.
Land use: Fishing, and utilization of water for irrigation.
Waterfowl: Breeding species include *Podilymbus podiceps*, *Phalacrocorax olivaceus*, *Anhinga anhinga*, *Egretta caerulea*, *Dendrocygna autumnalis* and *Jacana spinosa*. The area is particularly important for passage and wintering waterfowl; common species include *Ardea herodias*, *Anas discors*, *A. cyanoptera*, *A. clypeata*, *Aythya affinis*, *Fulica americana* and a variety of shorebirds. *Oxyura jamaicensis* occurs in small numbers.
Other fauna: *Dasypus novemcinctus* and *Ctenosaura similis* occur in the area.

Threats: The wetlands are being drained for agriculture, and there is a general increase in fishing and other human activities in the area.
Research and conservation: Preliminary faunal and floral surveys have been conducted by IRENA, and a proposal has been made for the establishment of a reserve.
References: Catastro & IRENA (1973); Dilger (1983).
Source: Milton Camacho and Janet Sandino.
Criteria for inclusion: 3a.

Lake Managua (Xolotlan) and the San Francisco del Carnicera marshes (7)

Location: 12°20'N, 86°20'W; north of Managua, Managua Department.
Area: 101,000 ha; (San Francisco del Carnicera marshes 1,583 ha).
Altitude: 39m.
Province and type: 8.16.4; 12.
Site description: A large permanent freshwater lake with muddy shoreline and associated marshes. Some of the most extensive marshes are along the northern shore of the lake near San Francisco del Carnicera and the mouth of the Rio Pacora.
Principal vegetation: Marshes with species of *Pistia*, *Heliconia* and Gramineae.
Land tenure: State owned.
Protection: None.
Land use: Fishing, transportation, the use of water for domestic consumption, and recreation. Agriculture, cattle ranching and wood-cutting in surrounding areas. The city of Managua lies near the south shore of the lake.
Waterfowl: A very important lake for both breeding and wintering waterfowl of a wide variety of species. The San Francisco del Carnicera marshes are particularly important for breeding birds. Common breeding species include *Phalacrocorax olivaceus*, *Anhinga anhinga*, *Egretta caerulea*, *E. alba*, *Mycteria americana*, *Eudocimus albus*, *Dendrocygna autumnalis*, *Cairina moschata*, *Aramus guarauna* and *Jacana spinosa*. *Jabiru mycteria* is reported to nest in the San Francisco del Carnicera marshes. Common passage and wintering species include *Anas discors*, a variety of shorebirds and *Larus atricilla*.
Other fauna: *Didelphis marsupialis*, *Procyon lotor* and *Odocoileus virginianus* occur around the lake.
Threats: There is considerable pollution in the Managua area from industrial waste, domestic sewage and effluents from food processing plants, and some pollution in the north from pesticide run-off from adjacent agricultural areas. The rate of eutrophication is increasing, and there is a general expansion in agricultural and ranching activities in surrounding areas.
Research and conservation: A major project for the cleaning up of the lake has recently been initiated with the support of the United Nations Environment Programme (UNEP); work to date has been confined to experimentation with methodology. It has been suggested that the badly polluted bay of Managua be cut off from the rest of the lake by a barrage.
Source: M. Fonseca, Octavio Saldana and Marisol Sanchez.
Criteria for inclusion: 2b & 3a.

Lago de Tisma and La Playuela (8)

Location: 12°05'N, 85°57'W; 20 km north of Granada, Departments of Managua, Masaya and Granada.
Area: 4,438 ha.
Altitude: 33m.
Province and type: 8.16.4; 09, 12 & 16.
Site description: A shallow depression along the Rio Tipitapa between Lake Managua and Lake Nicaragua, with extensive freshwater marshes and seasonally flooded grassland. The wetland normally dries out during the dry season. At very high water levels, Lake Managua overflows into the Rio Tipitapa, flooding the depression and creating a large shallow lake (Lago de Tisma). On rare occasions, the flooding extends to Lake Nicaragua. At high levels in Lake

Nicaragua, there is back-flooding into Lago de Tisma during the dry season. La Playuela is a small freshwater lake in the southern part of the marshes, near the shore of Lake Nicaragua.
Principal vegetation: Tall grasses, reeds and *Parkinsonia aculeota* scrub. In the dry tropical forest zone.
Land tenure: State owned.
Protection: Included within a Wildlife Refuge established in 1983.
Land use: Fishing, cattle ranching and wood-cutting. The grasslands are regularly burned to improve grazing.
Waterfowl: A very important breeding area for waterfowl and wintering area for Nearctic migrants. Common breeding species include *Nycticorax nycticorax*, *Cochlearius cochlearius*, *Egretta caerulea*, *E. thula*, *E. alba*, *Mycteria americana*, *Eudocimus albus*, *Ajaia ajaja*, *Dendrocygna autumnalis*, *Cairina moschata*, *Aramus guarauna*, *Aramides cajanea*, *Porphyrula martinica* and *Jacana spinosa*. *Jabiru mycteria* also breeds. Common migrants include *Ardea herodias*, *Anas discors*, *A. clypeata*, *Fulica americana*, a variety of shorebirds, and *Larus atricilla*.
Other fauna: *Rostrhamus sociabilis* is a common breeding bird, and *Caiman crocodilus* occurs.
Threats: The main threats to the region are a project to drain the whole area for rice cultivation and other agriculture (Proyecto de Riego Zambrano-Tisma), and a project to build a canal between Lake Managua and Lago de Tisma and pump water back into Lake Managua for the generation of hydroelectricity (Proyecto Armijo).
Research and conservation: Detailed investigations have been conducted in the area as part of a wider survey of areas of importance for wildlife in the Pacific Region of Nicaragua.
References: Catastro & IRENA (1977); Dilger (1983).
Source: Milton Camacho and Janet Sandino.
Criteria for inclusion: 2c & 3a.

Lago de Nicaragua (9)

Location: 11°00'-12°08'N, 84°40'-85°57'W; southern Nicaragua, in the Departments of Rivas, Granada, Chontales and Rio San Juan.
Area: c.870,000 ha.
Altitude: 32m.
Province and type: 8.16.4; 12.
Site description: A large freshwater lake, 165 km long and up to 70 km wide, with several large and many small islands, and extensive fringing marshes particularly at the mouths of the main rivers entering the lake. The lake drains into the Caribbean via the Rio San Juan. The most important wetland areas are described separately below.

Laguna de Nocarime (9a)

Location: 11°36'N, 85°51'W; 30 km SSE of Granada, Rivas Department.
Area: 2,328 ha.
Altitude: 32m.
Province and type: 8.16.4; 15 & 17.
Site description: A permanent shallow freshwater impoundment in a region of rice cultivation on the west shore of Lake Nicaragua.
Principal vegetation: Species of *Eichhornia*, *Pistia*, *Heliconia* and Gramineae.
Land tenure: State owned.
Protection: None.
Land use: Traditional fishing and utilization of water for irrigation; rice growing in surrounding areas.
Waterfowl: An important feeding area for waterfowl with large numbers of *Phalacrocorax olivaceus*, *Anhinga anhinga*, *Egretta thula*, *E. alba*, *Mycteria americana*, *Eudocimus albus* and *Dendrocygna autumnalis*, and small numbers of *Cairina moschata*. Common migrants include *Anas discors* and *Actitis macularia*.

Other fauna: Species recorded include the freshwater turtle *Chrysemys ornata*,and the fishes *Lepisosteus tropicus*, *Cichlasoma managuensis* and *C. citrinellum*.
Threats: The main threats are the construction of a dam and drainage for the cultivation of rice and sugar cane.
Source: R. Cisneros and Jose V. Morales.
Criteria for inclusion: 2b.

Estero El Junquillo (9b)

Location: 11°56'N, 85°29'W; on the eastern shore of Lake Nicaragua, 50 km east of Granada, Chontales Department.
Area: 2,750 ha.
Altitude: 32-35m.
Province and type: 8.16.4; 13.
Site description: A complex of shallow freshwater marshes and mudflats on the eastern shore of Lake Nicaragua.
Principal vegetation: Gramineae.
Land tenure: State owned.
Protection: None.
Land use: Agriculture, cattle ranching and wood-cutting in surrounding areas.
Waterfowl: A very important area for a wide variety of resident species and Nearctic migrants. Common breeding birds include *Phalacrocorax olivaceus*, *Tigrisoma lineatum*, *T. mexicanum*, *Nycticorax nycticorax*, *Nyctanassa violacea*, *Cochlearius cochlearius*, *Egretta tricolor*, *Mycteria americana*, *Eudocimus albus*, *Dendrocygna autumnalis*, *Cairina moschata*, *Aramus guarauna*, *Aramides cajanea* and *Laterallus ruber*. Common migrants include *Anas acuta*, *A. discors*, *Aythya affinis*, a variety of shorebirds, *Chlidonias nigra* and *Rynchops niger*.
Other fauna: *Caiman crocodilus* occurs.
Threats: Expansion of agriculture.
Source: E. Gomez and Janet Sandino.
Criteria for inclusion: 2c & 3a.

Islas El Nancital (9c)

Location: 11°44'N, 85°13'W; near the eastern shore of Lake Nicaragua, Chontales Department.
Area: 1,825 ha.
Altitude: 32-76m.
Province and type: 8.16.4; 03 & 13.
Site description: A group of small islands with surrounding marshes and muddy areas, close to the eastern shore of Lake Nicaragua between the mouth of the Rio Acoyapa and Estero Jalapa.
Principal vegetation: *Eichhornia crassipes*, *Typha* spp, *Hymenae courbaril*, *Pistia* spp and Gramineae.
Land tenure: State owned.
Protection: No legal protection, but the Hunting and Fishing Club of Chontales Department cooperates with IRENA in patrolling the area.
Land use: Fishing, agriculture and forestry.
Waterfowl: An important area for both resident waterfowl and Nearctic migrants, with the same species as site 9b.
Other fauna: *Odocoileus virginianus* and the fishes *Lepisosteus tropicus*, *Charcarinus* sp and *Pristis* spp occur.
Threats: Expansion of agriculture.
Source: E. Gomez and Janet Sandino.
Criteria for inclusion: 2c & 3a.

Estero El Chaparral (9d)

Location: 11°19'N, 84°52'W; 10 km northwest of Morillo, Chontales Department.
Area: 2,219 ha.
Altitude: 32-40m.
Province and type: 8.16.4; 13.
Site description: A complex of shallow freshwater marshes and muddy areas on the southeastern shore of Lake Nicaragua.
Principal vegetation: *Pachira aquatica* and Gramineae.
Land tenure: State owned.
Protection: None.
Land use: Agriculture and wood-cutting in surrounding areas.
Waterfowl: An important area for both resident waterfowl and Nearctic migrants, with the same species as site 9b.
Other fauna: *Iguana iguana* and *Basiliscus* spp occur.
Threats: Expansion of agriculture, cattle ranching and wood-cutting.
Source: E. Gomez and Janet Sandino.
Criteria for inclusion: 2c & 3a.

Bocano Santo Domingo and Pantano Llano Santa Emilia (9e)

Location: 11°10'N, 84°47'W; south of Morillo, Rio San Juan Department.
Area: 2,113 ha.
Altitude: 32-40m.
Province and type: 8.16.4; 13 & 16.
Site description: Freshwater marshes and seasonally flooded grassland along the southeastern shore of Lake Nicaragua, north of the Rio San Juan.
Principal Vegetation: *Pachira aguatica, Couroupita nicaraguensis, Pista* spp, *Eichhornia* sp and Gramineae.
Land tenure: State owned.
Protection: None.
Land use: Cattle ranching, wood-cutting and hunting.
Waterfowl: An important area for both resident waterfowl and Nearctic migrants. Common breeding species include *Phalacrocorax olivaceus, Tigrisoma lineatum, Nycticorax nycticorax, Nyctanassa violacea, Bubulcus ibis* (thousands), *Egretta caerulea, E. tricolor, Dendrocygna autumnalis, Amaurolimnas concolor, Aramides axillaris, A. cajanea, Porzana flaviventer, Laterallus exilis, L. albigularis, L. ruber* and *Porphyrula martinica.* Common migrants include *Ardea herodias, Anas acuta* (thousands), *A. discors, Aythya affinis*, a variety of shorebirds, *Chlidonias nigra* and *Rynchops niger.*
Other fauna: *Odocoileus virginianus* and *Caiman crocodilus* occur.
Threats: Expansion of ranching activities.
Source: E. Gomez and Janet Sandino.
Criteria for inclusion: 2c & 3a.

Marshes of the Rio San Juan (9f)

Location: 11°06'N, 84°43'W; 15 km SSE of Morillo, Rio San Juan Department.
Area: 2,950 ha.
Altitude: 32-40m.
Province and type: 8.16.4; 13 & 16.
Site description: Freshwater marshes and seasonally flooded grassland along the Rio San Juan, near the southeast corner of Lake Nicaragua.
Principal vegetation: *Pachira aquatica, Couroupita nicaraguensis, Pista* spp and Gramineae.
Land tenure: State owned.
Protection: None.
Land use: Cattle ranching and hunting.

Waterfowl: An important area for both resident waterfowl and Nearctic migrants, with the same species as site 9e and breeding *Jabiru mycteria.*
Other fauna: *Odocoileus virginianus, Caiman crocodilus* and *Megalops* spp occur.
Threats: Expansion of ranching activities.
Source: E. Gomez and Janet Sandino.
Criteria for inclusion: 2c & 3a.

Marshes of the Guadalupe Valley (9g)

Location: 10°56'-11°05'N, 84°45'-85°12'W; on the southern shore of Lake Nicaragua, Departments of Rio San Juan and Rivas.
Area: 26,950 ha.
Altitude: 32-50m.
Province and type: 8.16.4; 13 & 16.
Site description: Shallow freshwater marshes and seasonally flooded grassland along the south shore of Lake Nicaragua from Bocana Boca Ancha to Punta Pizote.
Principal vegetation: *Pachira aquatica, Couroupita nicaraguensis, Eichhornia* sp, *Pista* spp and Gramineae.
Land tenure: State owned.
Protection: None.
Land use: Cattle ranching and hunting.
Waterfowl: An important area for both resident waterfowl and Nearctic migrants, with the same species as sites 9e and 9f, including breeding *Jabiru mycteria.*
Other fauna: *Odocoileus virginianus* and *Caiman crocodilus* occur.
Threats: Expansion of ranching activities.
Source: E. Gomez and Janet Sandino.
Criteria for inclusion: 2c & 3a.

Islas Balsias, Isla Zapote, Isla Zapotillo and Isla de Zanate (9h)

Location: 11°05'-11°15'N, 84°51'-85°16'W; near the southern shore of Lake Nicaragua, Departments of Rio San Juan and Rivas.
Area: Islas Balsias 12.5 ha; Isla Zapote and Isla Zapotillo 75 ha; Isla de Zanate 20 ha.
Altitude: 32-77m.
Province and type: 8.16.4; 03 & 13.
Site description: Small rocky islands of recent volcanic origin with surrounding marshes; on the periphery of the Solentiname Archipelago at the south end of Lake Nicaragua.
Principal vegetation: Species of *Typha* and *Pistia, Pachira aquatica*, Gramineae, and scattered trees.
Land tenure: State owned.
Protection: None.
Land use: Wood-cutting and horticulture.
Waterfowl: The islands are important for both breeding waterfowl and Nearctic migrants. Common breeding species include *Phalacrocorax olivaceus* (thousands), *Tigrisoma lineatum, Nycticorax nycticorax, Nyctanassa violacea, Egretta caerulea, E. tricolor, E. alba* and *Dendrocygna autumnalis.* Common migrants include *Anas acuta, A. discors, Aythya affinis*, many shorebirds, *Larus atricilla, Chlidonias nigra* and *Rynchops niger.*
Other fauna: The very local Nicaraguan Grackle *Cassidix nicaraguensis* and the freshwater turtle *Chrysemys ornata* occur.
Threats: None known.
Source: Milton Camacho and Janet Sandino.
Criteria for inclusion: 2c & 3a.

Laguna de Bismuna (10)

Location: 14°37'-14°56'N, 83°18'-83°26'W; 80 km north of Puerto Cabezas, Caribbean Region.
Area: 48,340 ha.
Altitude: 0-10m.
Province and type: 8.16.4; 05, 07 & 08.
Site description: A large brackish coastal lagoon, up to 10m deep, with mangrove swamps and brackish marshes. The lagoon is separated from the sea by a sand barrier, and is flooded at high tides.
Principal vegetation: Mangrove swamps with *Avicennia germinans* and *Rhizophora mangle*. In a region of relatively undisturbed humid tropical forest.
Land tenure: State owned.
Protection: None.
Land use: Fishing; exploitation of timber in surrounding areas.
Waterfowl: A very rich area for waterfowl, with a wide variety of resident species and Nearctic migrants. Common breeding species include *Podiceps dominicus, Pelecanus occidentalis, Phalacrocorax olivaceus, Anhinga anhinga, Botaurus pinnatus, Ixobrychus exilis, Tigrisoma lineatum, T. mexicanum, Nycticorax nycticorax, Nyctanassa violacea, Cochlearius cochlearius, Egretta caerulea, E. thula, Mycteria americana, Jabiru mycteria, Eudocimus albus, Ajaia ajaja, Dendrocygna autumnalis, Cairina moschata, Amaurolimnas concolor, Aramides axillaris, Laterallus ruber, Heliornis fulica* and *Eurypyga helias*. Common migrants include *Ardea herodias, Anas americana, A. discors*, many shorebirds (particularly *Catoptrophorus semipalmatus* and *Actitis macularia*), and many Laridae.
Other fauna: The Osprey *Pandion haliaetus* is a common non-breeding visitor. Mammals include *Leo onca, Lutra anectens* and *Trichechus manatus*; reptiles include *Crocodylus acutus, Caiman crocodilus* and *Iguana iguana*; and the bull frog *Leptodactylus pentidactylus* occurs.
Threats: There are some problems with overfishing, and the surrounding areas are being deforested.
Research and conservation: An extremely rich area for wildlife, still relatively undisturbed. The Proyecto de Sistema Nacional de Areas Silvestres Protegidas (SINASIP) has identified this lagoon, together with the nearby Laguna de Pahara (site 11) and Cayos Miskitos (site 12), as a priority area for the establishment of a wildlife refuge (Refugio de Vida Silvestre). This would involve a ban on commercial hunting and fishing, the regulation of subsistence hunting and fishing, and a ban on forest exploitation.
References: INTURISMO (1980); Dilger (1983).
Source: Milton Camacho and M. Fonseca.
Criteria for inclusion: 2a, 2b & 3a.

Laguna de Pahara (11)

Location: 14°18'N, 83°17'W; 30 km NNE of Puerto Cabezas, Caribbean Region.
Area: 35,580 ha.
Altitude: 0-10m.
Province and type: 8.16.4; 05, 07 & 08.
Site description: A large saline coastal lagoon with mangrove swamps and brackish marshes, separated from the sea by a sand barrier and flooded at high tides.
Principal vegetation: Mangrove swamps with *Avicennia germinans* and *Rhizophora mangle*. In a region of relatively undisturbed humid tropical forest.
Land tenure: State owned.
Protection: None.
Land use: Fishing; exploitation of timber in surrounding areas.
Waterfowl: A very important area for breeding, passage and migrant waterfowl, with the same species as site 10.
Other fauna: Similar to site 10.
Threats: There are some problems with overfishing, and the surrounding areas are being deforested.

Research and conservation: The Proyecto de Sistema Nacional de Areas Silvestres Protegidas (SINASIP) has identified this lagoon, together with the nearby Laguna de Bismuna (site 10) and Cayos Miskitos (site 12), as a priority area for the establishment of a wildlife refuge. (See site 10.)
References: INTURISMO (1980); Dilger (1983).
Source: Milton Camacho and M. Fonseca.
Criteria for inclusion: 2a, 2b & 3a.

Cayos Miskitos (12)

Location: 14°20'N, 82°50'W; off the northeast coast of Nicaragua, 75 km southeast of Cabo Gracias a Dios, Caribbean Region.
Area: 810,000 ha including surrounding sea area.
Altitude: 0-5m.
Province and type: 8.16.4; 01, 03 & 05.
Site description: An archipelago of about 85 small islands (cays) with extensive coral reefs, in the Caribbean 20-60 km off the north coast.
Principal vegetation: Marine grasses in inshore waters.
Land tenure: State owned.
Protection: None.
Land use: A small indigenous population of Miskito Indians harvest land and marine resources. The islands are difficult of access, and seldom visited by outsiders.
Waterfowl: An important breeding area for *Pelecanus occidentalis*, and passage and wintering area for large numbers of shorebirds and Laridae.
Other fauna: There are large breeding colonies of *Fregata magnificens* and *Sula* spp. The archipelago also supports a population of the manatee *Trichechus manatus*, and includes one of the most important nesting grounds of the Green Sea Turtle *Chelonia mydas* in the Caribbean. The rich coral reefs support an abundant marine fauna.
Threats: There is some hunting of sea turtles.
Research and conservation: The Proyecto de Sistema Nacional de Areas Silvestres Protegidas (SINASIP) has identified the archipelago, along with Laguna de Bismuna (site 10) and Laguna de Pahara (site 11) on the adjacent mainland coast, as a priority area for the establishment of a wildlife refuge.
References: Dilger (1983).
Source: Milton Camacho.
Criteria for inclusion: 2a & 3a.

Laguna de Wounta (13)

Location: 13°37'N, 83°34'W; 40 km SSW of Puerto Cabezas, Caribbean Region.
Area: 36,290 ha.
Altitude: 0-5m.
Province and type: 8.16.4; 05, 07, 08, 09, 11 & 12.
Site description: A large brackish coastal lagoon with four islands, fringing mangrove swamps and brackish marshes; separated from the sea by a sandy littoral zone, and flooded at high tides. The lake is fed by the Rio Kukalaya, Rio Makakalaya and many smaller rivers through a complex of fresh to brackish lakes and marshes to the west and south of the main lagoon.
Principal vegetation: Mangrove swamps with *Avicennia germinans*, *Conocarpus erectus*, *Laguncularia racemosa* and *Rhizophora mangle*. In a region of humid tropical forest.
Land tenure: State owned.
Protection: None.
Land use: Fishing; exploitation of timber in surrounding areas.
Waterfowl: A very rich area for waterfowl, with almost the same variety of resident species and Nearctic migrants as site 10.

Other fauna: The Osprey *Pandion haliaetus* is a common non-breeding visitor. Mammals include *Tursiops gilli, Lutra anectens* and *Trichechus manatus*; reptiles include *Crocodylus acutus, Caiman crocodilus, Staurotypus salvinii* and *Iguana iguana*.
Threats: There are some problems with overfishing, and the surrounding areas are being deforested. There is a possibility that the coastal canal linking a chain of coastal lagoons to the south will be extended into the Laguna de Wounta, and greatly increase the accessibility of the area.
Research and conservation: An extremely rich area for wildlife, still relatively undisturbed. Preliminary faunal and floral surveys have been conducted by IRENA, and a proposal has been made for the establishment of a wildlife refuge in the area.
References: INTURISMO (1980); Dilger (1983).
Source: Milton Camacho and M. Fonseca.
Criteria for inclusion: 2a & 3a.

Lagunas de Prinzapolka (14)

Location: 13°25'N, 83°54'W; 90 km southwest of Puerto Cabezas, Caribbean Region.
Area: 18,390 ha.
Altitude: 0-20m.
Province and type: 8.16.4; 09, 11, 12 & 16.
Site description: A complex of riverine marshes, freshwater lakes and marshes, and seasonally flooded areas along the lower Rio Prinzapolka.
Principal vegetation: The main aquatic vegetation is species of *Pistia*. In the humid tropical forest zone, but most of the native vegetation has now been destroyed for agriculture.
Land tenure: State owned.
Protection: None.
Land use: Fishing; agriculture, cattle ranching and some exploitation of timber in surrounding areas.
Waterfowl: An important area for breeding waterfowl and Nearctic migrants, with almost the same species as site 10.
Other fauna: The Osprey *Pandion haliaetus* is a common non-breeding visitor.
Threats: Overfishing; the surrounding areas have been almost completely deforested and there is considerable disturbance from agricultural activities.
Research and conservation: Preliminary faunal and floral surveys have been conducted by IRENA, and a proposal has been made for the establishment of a recreation area (Area de Recreacion) in which hunting, fishing, agriculture and forest exploitation would be restricted.
References: INTURISMO (1980).
Source: Milton Camacho and M. Fonseca.
Criteria for inclusion: 3a.

Lagunas de Wankarlaya (15)

Location: 13°10'N, 83°55'W; 50 km WNW of Karawala, Caribbean Region.
Area: 11,110 ha.
Altitude: 5-30m.
Province and type: 8.16.4; 09, 11 & 12.
Site description: A complex of riverine marshes and over seventy-five permanent freshwater lakes and marshes, up to 10m deep, along the lower Rio Grande de Matagalpa.
Principal vegetation: The main aquatic vegetation is species of *Pistia*. In a region of relatively undisturbed humid tropical forest.
Land tenure: State owned.
Protection: None.
Land use: Fishing; forest exploitation and a little agriculture in surrounding areas.
Waterfowl: An important area for breeding waterfowl and Nearctic migrants, with almost the same species as site 10.

Other fauna: The Osprey *Pandion haliaetus* is a common non-breeding visitor. *Leo on* 1 occurs in the area, and reptiles include *Crocodylus acutus, Caiman crocodilus* and *Iguana iguana.*
Threats: Overfishing and forest clearance.
Research and conservation: The wetlands remain relatively undisturbed, and are accessible only by boat along the Rio Grande de Matagalpa. Preliminary faunal and floral surveys have been conducted by IRENA, and a proposal has been made for the establishment of a wildlife refuge incorporating the entire area.
References: INTURISMO (1980); Dilger (1983).
Source: Milton Camacho and M. Fonseca.
Criteria for inclusion: 3a.

The Rio Grande de Matagalpa Delta (16)

Location: 12°43'-13°02'N, 83°30'-83°47'W; south and west of Karawala, Caribbean Region.
Area: 74,240 ha.
Altitude: 0-10m.
Province and type: 8.16.4; 02, 05, 07, 08, 09, 11, 12 & 16.
Site description: The delta systems of the Rio Grande de Matagalpa and Rio Kurinwas, including the lower courses of the two rivers, associated riverine marshes, sandy beaches, saline lagoons with mangrove swamps near the coast, a complex of permanent fresh to brackish lakes and marshes, and adjacent low-lying land subject to seasonal inundation. A coastal navigation channel, the Canal Intercostal, runs from north to south across the delta and links it with the Rio Escondido and Bluefields City.
Principal vegetation: Mangrove swamps with *Avicennia germinans, Laguncularia racemosa, Rhizophora mangle, Hibiscus tiliaceus* and *Acrostichum aureum*; coastal scrub with *Coccoloba uvifera, Chrysobalanus icaco* and *Lonchocarpus guatemalensis*; and marshy savannas with *Rhynchospora mexicana, R. cephalotes, Bulbotyles spadicea, Scheria lindleyna, Cyperus polystachius* and *Dichroma radicans.* In a region of humid tropical broadleaf forest, with some *Pinus caribea* forest.
Land tenure: State owned.
Protection: None.
Land use: Fishing; some forest exploitation in surrounding areas. Much of the area is undisturbed.
Waterfowl: An important area for breeding waterfowl and Nearctic migrants, with almost the same species as site 10.
Other fauna: The Osprey *Pandion haliaetus* is a common non-breeding visitor. The manatee *Trichechus manatus* still occurs in the area, and a wide variety of reptiles and amphibians have been recorded, including *Boa constrictor, Rana palmipes* and *Leptodactylus pentadactylus.*
Threats: Overfishing and forest clearance. There is some disturbance along the coastal canal which provides easy access to the area, and this will increase if an existing project to continue the canal to Puerto Cabezas is implemented.
Research and conservation: Preliminary faunal and floral surveys have been conducted by IRENA, and a proposal has been made for the establishment of a wildlife refuge in the area.
References: INTURISMO (1980); Dilger (1983).
Source: Milton Camacho and M. Fonseca.
Criteria for inclusion: 2a & 3a.

Rio Indio (17)

Location: 10°55'N, 83°43'W; near San Juan del Norte, on the Costa Rican border, Caribbean Region.
Area: 16,500 ha.
Altitude: 0-10m.
Province and type: 8.16.4; 02, 07, 08, 09, 11, 12, 16 & 18.

Site description: A complex of slow-flowing rivers and their estuarine systems, with associated brackish to saline coastal lagoons, mangrove swamps, riverine marshes, small freshwater lakes, wet palm savannas, seasonally flooded grassland and swamp forest. The annual precipitation is very high (6,000 mm).
Principal vegetation: *Eichhornia crassipes* and species of *Typha* and *Pistia.*
Land tenure: No information.
Protection: None.
Land use: Wood-cutting.
Waterfowl: Species known to occur include *Aramides cajanea, Porphyrula martinica, Heliornis fulica, Eurypyga helias* and *Jacana spinosa.*
Other fauna: Known to be very rich in wildlife, but no details are available.
Threats: Exploitation of timber.
Research and conservation: The Proyecto de Sistema Nacional de Areas Silvestres Protegidas (SINASIP) has identified the region as a priority area for conservation, and has proposed the establishment of a 200,000 ha wildlife refuge which would include all the wetlands.
References: Dilger (1983).
Source: Milton Camacho.
Criteria for inclusion: 0.

PANAMA

INTRODUCTION

by **Francisco S. Delgado**

The Republic of Panama covers an area of 77,082 km^2, and has a population estimated at almost two million. The country forms a narrow land bridge between the North and South American continents and possesses an extremely diverse flora and fauna with major elements from both continents. It has 1,160 km of coastline on the Caribbean and 1,697 km on the Pacific, the two coasts being only 65 km apart at the narrowest point in the middle of the country. The current status of the diverse wetland systems of Panama and their avifauna has recently been described by Delgado (1983).

The best known wetland in Panama is the Panama Canal which includes an artificial lake of 32,000 ha (Gatun Lake). Not only is this the best studied wetland in the country, but it is also that which enjoys the best protection, conservation and management. The principal estuarine zones are in the Pacific watershed, the largest being that of the estuaries of the Rio Tuira and its affluents which form the great Golfo de San Miguel (433,000 ha) in Darien in the east. Next in size and importance is the estuarine zone of the Golfo de Parita (272,000 ha), with large intertidal areas of mangroves and the largest breeding colonies of waterfowl in the country. In general, the wetlands and avifauna of this region have been well studied, in contrast to those of Darien which remain very poorly known. A third large estuarine system on the Pacific coast is in the delta region of the Chico and Chorcha rivers in the west (262,000 ha).

In addition to Gatun Lake, the main lacustrine systems of Panama include the Sansan and Changuinola lagoons, a region of 141,000 ha of little studied lagoons, marshes and channels in the Caribbean watershed near the border with Costa Rica. Lago Bayano in the interior of eastern Panama is also worthy of mention. This artificial lake of 195,000 ha was created by the Compania Hidroelectrica; it is currently in the eutrophic phase and is gradually assuming importance for waterfowl. The Diablo, Jugli and Samani lagoons in the rain forests of Boca del Toro in the west are also worthy of special mention, although their structure and avifauna remain completely unknown. Other small lacustrine systems include those of La Yeguada, Volcan and Fortuna, in the mountainous regions of Panama.

Very little work has been conducted on the waterfowl of Panama except in the central regions of the country. The estuaries of the Rio Tuira region in Darien and the lagoons in the rain forest of the Caribbean lowlands are particularly poorly known. Very little information is available on waterfowl hunting except in the region of Gatun Lake, and this clearly requires greater attention and study. With respect to bird migration, studies involving banding programmes have recently been initiated in the region of the Golfo de Parita.

Delgado (1983) has suggested that the main thrust in research and management projects should be directed to the development of an integrated study of the wetlands and a national plan for environmental education at all levels. This would demonstrate to the general public the importance of these habitats in the country, and the necessity to conserve them. A broad programme of this type could only be achieved by means of a permanent exchange of local and international information and technical expertize, and with the support of international bodies. It is also necessary to determine a policy of harmonious development which takes into consideration both the value of the wetlands as a natural resource and the development needs of the country.

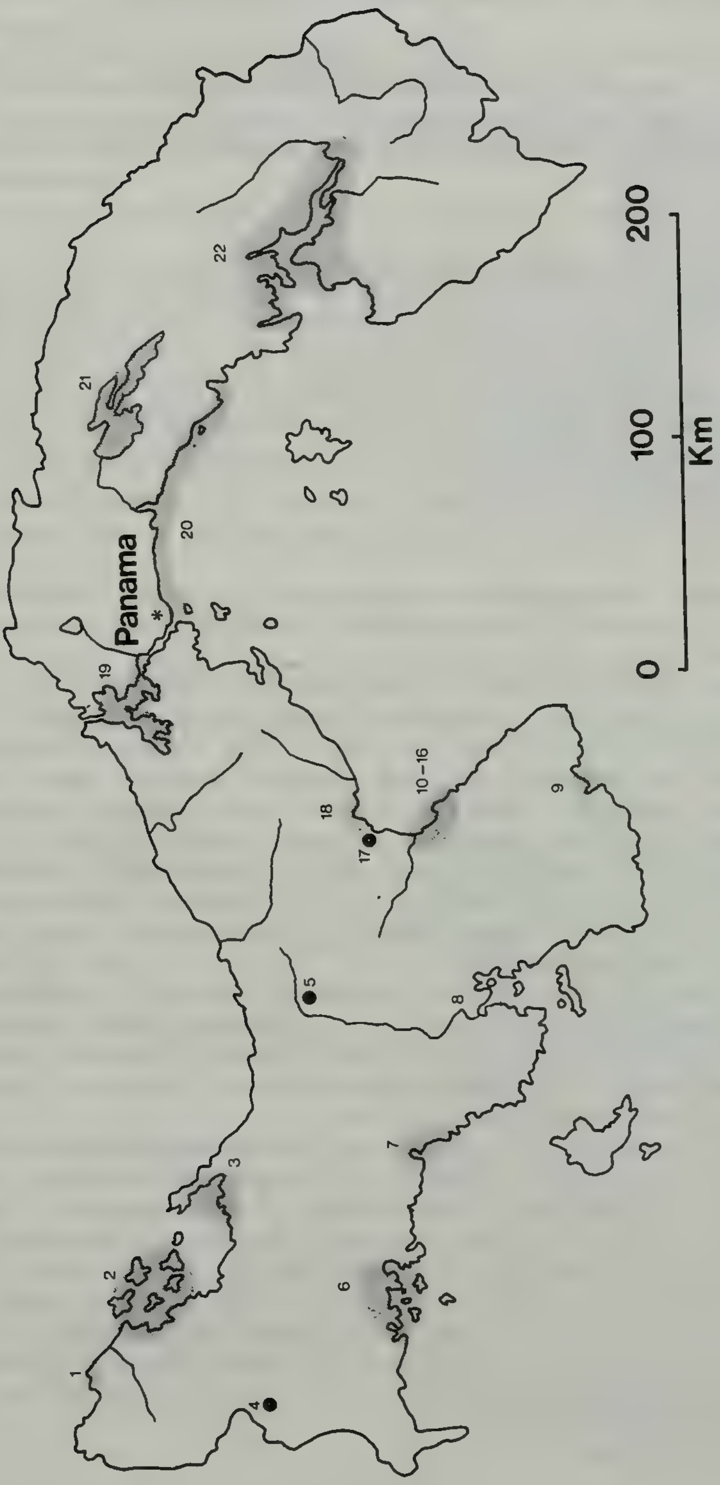
Substantial support has been obtained from World Wildlife Fund and the U.S. Agency for International Development for a four year project in environmental sciences. Funds will be devoted to ensuring that the various conservation organizations in Panama work with common aims, communicate efficiently between themselves, organize campaigns of environmental education and finance certain projects. It is to be hoped that this donation will provide some support for the Panamanian wetlands programme.

Major Threats to Wetlands and Waterfowl

As has already been indicated by Delgado (1983), the most serious threats to wetland ecosystems in western Panama, (e.g. Chiriqui and Bocas del Toro) are potential pollution from oil, mineral residues and pesticides. In the central zone, in addition to the problem of contamination with pesticides, there are threats from drainage for agricultural purposes, the construction of salt pans and shrimp ponds, and the exploitation of mangroves.

The avifauna of all the aquatic ecosystems of the Pacific watershed of Panama is threatened by excessive hunting. However, little is known about the situation in the wetlands of the Caribbean lowlands. In general, the wetlands are not affected by the activities of tourism or local recreation.

PANAMA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WETLANDS

Site descriptions based on data sheets provided by Francisco S. Delgado, information received from Brian A. Harrington and Robert S. Ridgely, and the literature.

Sansan and Changuinola Lagoons (1)

Location: 9°30'N, 82°32'W; on the Caribbean coast, 5 km east of the Costa Rican border, Bocas del Toro Province.
Area: 6,500 ha.
Altitude: 0-5m.
Province and type: 8.16.4; 05, 07, 08, 09, 11, 12 & 18.
Site description: A complex of fresh to brackish lakes, up to 10m deep, swamps, riverine marshes and swamp forest in the lower basin of the Rio Sansan and Rio Changuinola, with low mangrove swamps and sandy beaches along the adjacent coast. Salinities range from fresh in the lakes and riverine marshes to 25 p.p.t. near the coast. The water level in the lakes is relatively stable, but the level in the rivers fluctuates seasonally, and the swamp forests partially dry out during the dry season.
Principal vegetation: Marshes with *Pistia stratiotes*, *Eichhornia crassipes* and *Gynerium* sp; mangrove swamps with *Avicennia germinans*, *Laguncularia racemosa* and *Rhizophora mangle*; swamp forest with *Prioria copaeifera* and the palm *Raphia taedigera*. In the humid tropical forest zone.
Land tenure: The mangroves are state owned; the swamp forests and marshes are state owned with concessions for forest exploitation; surrounding areas are privately owned.
Protection: None.
Land use: Fishing, hunting of ducks and turtles, illegal hunting of manatees, cattle ranching, and forest exploitation. Cultivation of bananas in adjacent areas.
Waterfowl: A very important area for a wide variety of breeding, passage and wintering waterfowl, but no census data are available. Resident species include *Podiceps dominicus*, *Pelecanus occidentalis*, *Phalacrocorax olivaceus*, *Anhinga anhinga*, *Tigrisoma lineatum*, *T. fasciatum*, *Cochlearius cochlearius*, *Egretta tricolor*, *E. thula*, *E. alba*, *Mycteria americana*, *Mesembrinibis cayennensis*, *Ajaia ajaja*, *Amaurolimnas concolor*, *Aramides axillaris*, *A. cajanea*, *Porzana flaviventer*, *Laterallus albigularis*, *Porphyrula martinica*, *Heliornis fulica*, *Eurypyga helias* and *Jacana spinosa*. Passage migrants and winter visitors include *Ardea herodias*, *Anas americana*, *A. acuta*, *A. discors*, *A. clypeata*, *Aythya affinis*, *Porzana carolina*, *Fulica americana*, many Nearctic shorebirds, a variety of Laridae and *Rynchops niger*.
Other fauna: Mammals include the Central American Otter *Lutra anectens*, manatee *Trichechus manatus* and Paca *Agouti paca*. Reptiles include *Crocodylus acutus*, *Caiman crocodilus* and freshwater turtles of the genera *Kinosternon* and *Chrysemys*. The sea turtles *Chelonia mydas* and *Caretta caretta* occur along the coast.
Threats: The principal threat is drainage for banana plantations and cattle ranching. There has been a great expansion in economic development in the region in recent years, and a complex network of drainage and irrigation canals has been constructed. There is some pollution from pesticide run-off, and excessive hunting is threatening manatee and turtle populations.
Research and conservation: The region possesses a great diversity of wetland habitats still in relatively unspoiled condition. However, very little work has been conducted on the fauna and flora, and there is now an urgent need for a detailed ecological study of the area to determine ways in which economic development and conservation can be integrated in the region.
References: Delgado (1983).
Source: Francisco S. Delgado.
Criteria for inclusion: 2a, 2b & 3a.

Bocas del Toro Archipelago and adjacent Laguna de Chiriqui (2)

Location: 9°15'N, 82°10'W; east of Almirante, Bocas del Toro Province.
Area: 9,800 ha on the mainland; area on the islands unknown.
Altitude: 0m.
Province and type: 8.16.4; 06, 07 & 08.
Site description: Wetlands at the western end of Laguna de Chiriqui, a large shallow sea bay with numerous large and small islands. The wetlands include the floodplains along the southwest shore of the lagoon and at Punta Valiente, and coastal areas of the Bocas del Toro islands, including Swampo de Almirante (2,400 ha) and Swampo Punta Lauro (7,400 ha).
Principal vegetation: Mangrove swamps.
Land tenure: The mangrove areas are state owned; the ranches are privately owned.
Protection: None.
Land use: Fishing and hunting. Agriculture, cattle ranching and forest exploitation is surrounding areas.
Waterfowl: No information.
Other fauna: No information.
Threats: Drainage for agriculture and ranching, pollution from pesticides, excessive forest exploitation and hunting. There is a potential threat of pollution from a new oil pipeline being constructed from the Pacific coast to the Atlantic coast.
References: Delgado (1983).
Source: Francisco S. Delgado.
Criteria for inclusion: 0.

Peninsula de Valiente and Diablo, Jugli and Samani Lakes (3)

Location: 8°55'N, 81°50'W; at the eastern end of Laguna de Chiriqui, Cricamola District.
Area: Unknown.
Altitude: 0m.
Province and type: 8.16.4; 07, 08, 09, 11 & 12.
Site description: Wetlands at the southeastern end of Laguna de Chiriqui, including the delta marshes of Rio Diablo and several other small rivers, Bahia Azul, and the freshwater lakes Laguna de Samani and Laguna de Jugli (3,500 ha), and Laguna de Rio Diablo (500 ha).
Principal vegetation: No information. In the humid tropical forest zone.
Land tenure: Mainly state owned.
Protection: None.
Land use: Some forestry exploitation. The area is difficult of access, and little disturbed.
Waterfowl: No information.
Other fauna: No information.
Threats: No information.
References: Delgado (1983).
Source: Francisco S. Delgado.
Criteria for inclusion: 0.

Lagunas de Volcan (4)

Location: 8°46'N, 82°40'W; 2 km west of Volcan, Chiriqui Province.
Area: 12 ha.
Altitude: 1,200m.
Province and type: 8.16.4; 12.
Site description: Three small freshwater lakes, up to 20m deep, in a valley on the slopes of a large volcano. Water levels fluctuate by up to 1m according to rainfall
Principal vegetation: Little vegetation; some fringing marshes with *Typha* sp and Cyperaceae.
Land tenure: Privately owned.
Protection: The lakes were declared protected many years ago, but this has apparently lapsed. The area has been fenced by the owners, access is restricted, and hunting is prohibited.

Land use: Traditional fishing, some recreation and some tourism. Cattle ranching and agriculture in surrounding areas.
Waterfowl: A wide variety of resident and migratory waterfowl have been recorded, but no census data are available. Resident species include *Podilymbus podiceps, Podiceps dominicus*, several Ardeidae, *Oxyura dominica, Aramides cajanea, Laterallus albigularis, Porphyrula martinica* and *Jacana spinosa.* Migrants include *Anas discors, Fulica americana* and some Nearctic shorebirds. *Vanellus chilensis* has recently been recorded for the first time in this region.
Other fauna: There are several endemic fish species of the families Poecillidae and Pimellodidae. *Crocodylus acutus* may occur. Nearby forests have a rich fauna with a high degree of endemism.
Threats: With improved access, more people are now visiting the lakes, polluting them with rubbish and causing a considerable amount of disturbance. The main threat, however, is the recent construction of an airport close to the area.
Research and conservation: The most important lacustrine system in the mountains of western Panama. Further studies should be conducted in the area, and the possibility of re-establishing a protected area investigated with the owners.
References: Blake (1958); Edwards & Loftin (1971); Eisenmann & Loftin (1972b); Delgado (1983); Rincon (undated).
Source: Francisco S. Delgado.
Criteria for inclusion: 2a, 2b & 3a.

Laguna Yeguada (5)

Location: 8°28'N, 80°52'W; 45 km northwest of Aguadulce, Calobre District.
Area: 100 ha.
Altitude: 650m.
Province and type: 8.16.4; 12.
Site description: A small freshwater lake with fringing marshes, on the Pacific slope of the eastern Cerro Santiago.
Principal vegetation: Small patches of *Typha* sp, with low shrubs in surrounding areas.
Land tenure: State owned.
Protection: Within a Forest Reserve.
Land use: Fishing, hunting, recreation and production of hydroelectricity; forestry, particularly with exotic species, in surrounding areas.
Waterfowl: Poorly known. *Podilymbus podiceps* and *Podiceps dominicus* breed; *Anas discors* and a variety of shorebirds occur on passage and in winter.
Other fauna: No information.
Threats: Disturbance from recreation activities and excessive hunting.
References: Delgado (1983).
Source: Francisco S. Delgado.
Criteria for inclusion: 3a.

Mangrove Swamps and Estuaries in David District (6)

Location: 8°17'N, 82°20'W; south and east of David, Chiriqui Province.
Area: c.50,000 ha.
Altitude: 0-10m.
Province and type: 8.16.4; 02, 05, 06, 07, 08, 09, 11, 13, 16 & 17.
Site description: The estuarine systems of the Rio Pedregal, Rio Chico, Rio Chorcha and several smaller rivers, with extensive seasonal riverine marshes, brackish estuarine marshes, mangrove swamps, intertidal mudflats and sandy beaches. The riverine marshes flood during the rainy season (October and November) and dry out during the dry season. The estuarine marshes and mangrove swamps are subject to tidal influence up to 3 km inland. Salinities range from fresh to 25 p.p.t.
Principal vegetation: Mangrove swamps; marshes with species of *Nufar, Pistia* and *Eichhornia.*

Land tenure: The estuaries and mangroves are state owned, with concessions for shrimp farming; the seasonal marshes are privately owned.
Protection: None.
Land use: Subsistence and commercial fishing, shrimp fishing, cutting of mangroves for timber and charcoal, cultivation of rice, and cattle ranching.
Waterfowl: Thought to be a very important area for breeding, passage and wintering waterfowl, but few data are available. Resident species are known to include *Pelecanus occidentalis, Anhinga anhinga, Tigrisoma mexicanum, Nycticorax nycticorax, Nyctanassa violacea, Cochlearius cochlearius, Egretta tricolor, E. thula, E. alba, Mycteria americana, Eudocimus albus, Ajaia ajaja, Dendrocygna autumnalis, Cairina moschata, Oxyura dominica, Amaurolimnas concolor, Aramides cajanea, Laterallus albigularis, Porphyrula martinica* and *Jacana spinosa.* Passage and wintering birds include *Anas americana, A. discors, A. clypeata*, many shorebirds (notably *Haematopus palliatus, Charadrius semipalmatus, Limosa fedoa, Numenius phaeopus, Catoptrophorus semipalmatus, Arenaria interpres* and *Calidris mauri*), *Larus atricilla* and *Chlidonias nigra.*
Other fauna: *Pandion haliaetus* is a common winter visitor. The Central American Otter *Lutra anectens* occurs along with a rich terrestrial mammalian fauna. Reptiles include *Crocodylus acutus, Caiman crocodilus* and fresh water turtles of the genera *Kinosternon* and *Chrysemys.*
Threats: An oil pipeline through the wetlands has caused some pollution from small leaks, and poses a potential threat of major pollution in the future. There is a considerable amount of pollution from pesticide run-off from adjacent rice cultivation. Mangroves are being destroyed to provide land for rice cultivation and ranching, and excessive hunting is affecting populations of *Dendrocygna autumnalis* and *Cairina moschata.*
Research and conservation: The largest mangrove ecosystem in western Panama, very rich in wildlife and of great economic importance for its fisheries. The fauna and flora have never been studied in any detail, and clearly merit further investigation.
References: Illueca (1977); Tejera *et al* (1980); Delgado (1983); Rincon & Mendoza (1984).
Source: Francisco S. Delgado.
Criteria for inclusion: 2b, 2c & 3a.

Puerto Vidal-Bobi and the lower Rio Tabasara (7)

Location: 8°07'N, 81°44'W; 80 km west of Santiago, Las Palmas District.
Area: 12,000 ha.
Altitude: 0-5m.
Province and type: 8.16.4; 02, 06, 07, 08, 09, 11 & 17.
Site description: An extensive estuarine system with fresh to brackish riverine marshes, mangrove swamps and intertidal mudflats at Puerto Vidal-Bobi, and the smaller estuarine system of the nearby Rio Tabasara.
Principal vegetation: Mangrove swamps.
Land tenure: The mangrove areas are state owned; the surrounding areas are privately owned.
Protection: None.
Land use: Fishing, hunting and the cultivation of rice; cattle ranching and forestry in surrounding areas.
Waterfowl: An important area for breeding, passage and wintering waterfowl, with almost the same species as estuaries in the David district (site 6). The area is particularly important for breeding and roosting *Dendrocygna autumnalis.*
Other fauna: Similar to estuaries in the David district (site 6).
Threats: Drainage for rice cultivation, destruction of mangroves for timber and fuel, pollution from pesticide run-off, and excessive hunting.
References: Delgado (1983).
Source: Francisco S. Delgado.
Criteria for inclusion: 3a.

Rio San Pablo Estuary (8)

Location: 7°53'N, 81°13'W; 35 km southwest of Santiago, Veraguas Province.
Area: 5,000 ha.
Altitude: 0-10m.
Province and type: 8.16.4; 02, 04, 05, 06, 07, 08, 09, 11, 16 & 17.
Site description: The estuarine system of the Rio San Pablo, with fresh to brackish riverine marshes and extensive mangrove swamps; there are sandy beaches and some rocky areas at the river mouth. The marshes are largely seasonal, flooding during the rainy season (October and November); the coastal marshes and mangrove swamps are subject to tidal influence. Salinities range from fresh to 25 p.p.t.
Principal vegetation: Mangrove swamps with *Avicennia germinans, Conocarpus erectus, Laguncularia racemosa, Pelliciera rhizophorae* and *Rhizophora mangle*; marshes with *Eichhornia crassipes* and *Pistia stratiotes*; beach communities with *Coccoloba uvifera.*
Land tenure: The mangrove swamps and riverine marshes are state owned; other areas are privately owned.
Protection: None.
Land use: Fishing, cutting of mangroves for timber and fuel, duck hunting, some reed-cutting, cattle ranching, and rice cultivation.
Waterfowl: An important area for breeding, passage and wintering waterfowl, with almost the same species as the estuaries in the David District (site 6).
Other fauna: *Pandion haliaetus* is a common winter visitor. Mammals include the Central American Otter *Lutra anectens*; reptiles include *Crocodylus acutus, Caiman crocodilus* and freshwater turtles of the genera *Kinosternon* and *Chrysemys.* There is an abundant fish and shrimp fauna.
Threats: The principal threats are the cutting of mangroves for timber and fuel, pollution with pesticide run-off from adjacent rice cultivation, and excessive hunting.
Research and conservation: One of the largest estuarine systems in Veraguas Province, still relatively undisturbed.
References: Illueca (1977); Delgado (1983).
Source: Francisco S. Delgado.
Criteria for inclusion: 3a.

The Rio Tonosi Delta and Isla de Cañas (9)

Location: 7°22'N, 80°22'W; 5 km south of Tonosi, Los Santos Province.
Area: 4,300 ha.
Altitude: 0-5m.
Province and type: 8.16.4; 02, 05, 06, 07, 08, 09, 11, 16 & 17.
Site description: An estuarine and delta system with sandy beaches, extensive intertidal mudflats, mangrove swamps, seasonal fresh to brackish marshes, seasonally inundated grassland and large areas of rice cultivation. Isla de Cañas is a large sandy island in the delta. The riverine marshes and adjacent grassland are flooded during the rainy season (maximum flooding in November), and dry out almost completely during the dry season; the coastal marshes and mangrove swamps are subject to tidal influence. Salinities range from fresh to 30 p.p.t.
Principal vegetation: Mangrove swamps with *Avicennia germinans, Conocarpus erectus, Laguncularia racemosa, Pelliciera rhizophorae* and *Rhizophora mangle*; marshes with *Eichhornia crassipes* and *Pistia stratiotes*; beach communities with *Hippomaea mancinella*; grovesof the palm *Bactris* sp along streams; woodland with *Erythrina* sp in drier areas; and rice fields.
Land tenure: The mangroves, marshes and beaches are state owned; the island of Cañas is partly privately owned, and partly owned by a local commune; seasonally flooded grassland and cultivated areas are privately owned.
Protection: No effective protection, although the basin of the Rio Tonosi is in a zone subject to special controls, and there is legislation concerning the cutting of mangroves.
Land use: Fishing, collection of sea turtle eggs, cutting of mangroves, cattle ranching, and rice cultivation.

Waterfowl: An important area for breeding, passage and wintering waterfowl, with almost the same species as estuaries in the David District (site 6). In 1981, breeding colonies of Ardeidae at the Cienaga El Lagarto and Cienaga de Rio Viejo held 157 pairs of *Bubulcus ibis*, 4 pairs of *Cochlearius cochlearius*, 6 pairs of *Butorides virescens* and 32 pairs of *Eudocimus albus*. The area is particularly important for breeding *Dendrocygna autumnalis*.
Other fauna: *Pandion haliaetus* occurs in winter. Mammals include *Lutra anectens, Procyon lotor, P. cancrivorus* and *Agouti paca*. Reptiles include *Crocodylus acutus, Caiman crocodilus* and the sea turtle *Chelonia mydas*. Important commercial fishes include species of Carangidae, Lutjianidae and Centropomidae.
Threats: The principal threats are the drainage of the marshes for agriculture, the destruction of mangroves (particularly near Cañas), and pollution with pesticide run-off from rice-growing areas. Excessive hunting and associated disturbance are affecting duck populations, and *Dendrocygna autumnalis* has been heavily persecuted as a pest on rice crops. Despite a national programme to protect the sea turtles, their eggs are still being collected on a commercial scale.
Research and conservation: Some preliminary faunal and floral surveys have been conducted, but detailed studies are now called for, particularly with respect to pesticide problems and crop damage by *Dendrocygna autumnalis*.
References: Delgado (1983).
Source: Francisco S. Delgado.
Criteria for inclusion: 3a.

Peñon de La Honda and the Monjas-Bayano Marshes (10)

Location: 7°56'N, 80°18'W; 3 km SSE of Chitre, Herrera Province.
Area: 500 ha.
Altitude: 0m.
Province and type: 8.16.4; 02, 03, 04, 05, 06, 07, 08, 09, 11 & 17.
Site description: Peñon de La Honda is a small rocky island two km offshore. The Monjas-Bayano marshes are a coastal belt of intertidal mudflats, sand dunes, mangrove swamps, brackish lagoons and salt pans, with several small rivers and associated freshwater marshes; these marshes are bordered inland by agricultural land and pasture land. The coastal marshes are subject to tidal influence; salinities range from fresh to 30 p.p.t., the salinity in the lagoons falling considerably after heavy rains.
Principal vegetation: Low thorn scrub and cacti, principally *Arthocereus* sp, on Peñon de La Honda. Mangrove swamps with *Avicennia germinans, Conocarpus erectus, Laguncularia racemosa* and *Rhizophora mangle*; marshes with halophytic vegetation; dune communities with *Caesalpinia* sp and various cacti; and some *Hippomaea mancinella*.
Land tenure: Peñon de La Honda, the mangrove swamps, the coastal marshes and the salt pans are state owned, but some of the salt pans are leased to private individuals for salt extraction and shrimp farming; other areas are privately owned.
Protection: Peñon de La Honda is a Faunal Refuge established in 1982. Other areas are unprotected, but there are regulations concerning the cutting of mangroves, salt extraction and shrimp farming.
Land use: Fishing, salt extraction, the harvesting of shrimps and molluscs, the cutting of mangroves for timber, and the removal of sand for building purposes. Some guano is collected at the sea-bird colony on Peñon de La Honda, and there is intensive agriculture inland.
Waterfowl: An important area for breeding, passage and wintering waterfowl, with the same species as other wetlands in the Chitre area (see site 11). There is a large breeding colony of Ciconiiformes, principally *Bubulcus ibis* and *Eudocimus albus*, on Peñon de La Honda, the birds flying to the coastal marshes and adjacent agricultural land to feed.
Other fauna: There is a breeding colony of sea-birds on Peñon de La Honda.
Threats: The principal threat is the destruction of mangroves to provide areas for shrimp ponds. Fishing activities cause a considerable amount of disturbance and there is a potential threat from shrimp farmers wishing to control birds feeding on shrimps. The breeding colony on Peñon de La Honda is disturbed by guano collectors, fishermen and tourists in general. A lighthouse has recently been built on the island and this will have some effect on the colony.

Research and conservation: Detailed faunal and floral surveys have been carried out, particularly at Peñon de La Honda. Protection in the Faunal Refuge should be improved, and access restricted, especially during the breeding season. Further destruction of the coastal mangroves should be prohibited, both for economic reasons and because the mangroves provide a vital feeding area for birds breeding on Peñon de La Honda.
References: Delgado (1980a, 1981 & 1983); Chang & Rodriguez (1981).
Source: Francisco S. Delgado.
Criteria for inclusion: 2c & 3a.

Cienaga de Chitre (11)

Location: 7°59'N, 80°25'W; 1 km ENE of Chitre, Herrera Province.
Area: 350 ha.
Altitude: 0-10m.
Province and type: 8.16.4; 07, 08 & 12.
Site description: A permanent brackish lagoon, up to 1.8m deep, with mangrove swamps and brackish marshes, and a seasonal freshwater lake, up to 1.2m deep, with surrounding marshes; in the valley of the Rio La Villa. Water levels fluctuate widely, and the freshwater lake dries out completely for two months in the dry season. The lake is artificial; it was created many years ago during the construction of a nearby airport.
Principal vegetation: Mangrove swamps with *Avicennia germinans, Conocarpus erectus, Laguncularia racemosa* and *Rhizophora mangle*; marshes with species of *Typha, Nufar* and *Nymphoides*; scrub with *Prosopis* sp and *Caesalpinia* sp. In the premontanedry forest zone.
Land tenure: The freshwater lake is privately owned; other areas are state owned.
Protection: No habitat protection. The airport authorities restrict access to the freshwater lake.
Land use: Livestock grazing around the freshwater lake. There is now very little hunting in the area.
Waterfowl: An important area for breeding, passage and wintering waterfowl of a wide variety of species. There is a large breeding colony of Ardeidae and other species at the freshwater lake. In August 1983, this held over 2,000 pairs, principally *Bubulcus ibis* with small numbers of *Anhinga anhinga, Nycticorax nycticorax, Cochlearius cochlearius, Egretta tricolor, E. alba* and *Eudocimus albus*. Other species resident in the area include *Podilymbus podiceps, Podiceps dominicus, Butorides virescens, Egretta thula, Aramides cajanea, Porphyrula martinica* and *Jacana jacana*. Common passage migrants and winter visitors include *Egretta caerulea, Ardea herodias, Mycteria americana, Anas discors* and many shorebirds, notably *Actitis macularia, Limnodromus griseus, Calidris mauri, C. minutilla* and *Himantopus himantopus*.
Other fauna: *Buteogallus anthracinus* is common in the mangroves, and *Pandionhaliaetus* occurs in winter. The Central American Otter *Lutra anectens* has been recorded in the nearby river, and *Procyon lotor* and *P. cancrivorus* occur in the marshes. Reptiles include *Crocodylus acutus, Boa constrictor, Ctenosaura similis* and *Iguana iguana*.
Threats: The lagoon is heavily polluted with domestic sewage and rubbish.
Research and conservation: Detailed faunal and floral surveys have been carried out, and a proposal has been made for the establishment of a Municipal Sanctuary for waterfowl at the freshwater lake.
References: Delgado (1980d & 1983); Chang (1981a).
Source: Francisco S. Delgado.
Criteria for inclusion: 3a.

Playa Monagre and wetlands near La Villa de Los Santos (12)

Location: 8°00'N, 80°25'W; 2 km east of Chitre, Herrera Province.
Area: 750 ha.
Altitude: 0-3m.
Province and type: 8.16.4; 05, 06, 07 & 08.

Site description: A complex of salt pans, up to 30 cm deep, mangroves swamps and brackish to saline marshes near the mouth of the Rio La Villa, and adjacent sandy beaches and intertidal mudflats. Salinities range from 15-32 p.p.t., and water levels fluctuate considerably according to local rainfall and the tides.
Principal vegetation: Mangrove swamps with *Avicennia germinans, Conocarpus erectus, Pelliciera rhizophorae* and *Rhizophora mangle*; marshes with halophytic vegetation and a little *Typha* sp; coastal scrub with *Prosopis* sp, *Caesalpinia* sp and *Arthocereus* sp. In the premontane dry forest zone.
Land tenure: State owned, with some areas leased to private individuals for salt extraction and shrimp farming.
Protection: The exploitation of mangroves along the Rio La Villa, as elsewhere in Panama, is subject to restrictions, but otherwise the area is unprotected.
Land use: Salt extraction, shrimp farming, some cutting of mangroves, and some fishing. Playa Monagre is a popular beach resort, and there is intensive agriculture inland.
Waterfowl: An important feeding area for a wide variety of resident and migratory waterfowl, particularly shorebirds and Laridae, with almost the same species as Playa El Agallito and adjacent marshes (site 13).
Other fauna: *Pandion haliaetus* occurs in winter. Mammals include the Central American Otter *Lutra anectens, Procyon lotor* and *P. cancrivorus*; reptiles include *Crocodylus acutus, Caiman crocodilus* and species of *Kinosternon* and *Chrysemys*. The mangroves support a very rich fish and molluscan fauna.
Threats: The area has been modified by the construction of salt pans and shrimp ponds, and this is likely to continue.
Research and conservation: Some faunal and floral surveys have been carried out, but the area remains relatively poorly known and further investigation is required.
References: Delgado (1983).
Source: Francisco S. Delgado.
Criteria for inclusion: 3a.

Playa El Agallito and adjacent wetlands (13)

Location: 8°00'N, 80°26'W; 2 km northeast of Chitre, Herrera Province.
Area: 1,000 ha.
Altitude: 0-3m.
Province and type: 8.16.4; 06, 07 & 08.
Site description: A complex of salt pans, up to 60 cm deep, and brackish to saline marshes including the Albinas de Chitre and Albinas de Monagrillo; and the adjacent coastal fringe of mangrove swamps and broad intertidal mudflats near the artificial beach of Playa El Agallito. Salinities range from 5-38 p.p.t., and water levels fluctuate considerably according to local rainfall and the tides.
Principal vegetation: Mangrove swamps with *Avicennia germinans, Conocarpus erectus, Laguncularia racemosa, Pelliciera rhizophorae, Mora* sp and *Rhizophora mangle*; and coastal scrub with *Prosopis* sp, *Caesalpinia* sp and *Arthocereus* sp.
Land tenure: State owned, with some areas leased to private individuals for salt extraction and the development of a tourist resort.
Protection: In January 1984, the area was declared a site of national biological importance, and a biological station is currently being built.
Land use: Salt extraction, shrimp fishing and other fishing, the cutting of mangroves for timber and charcoal, and recreation along the beach. Some houses and recreation facilities have been built by the artificial beach at Playa El Agallito.
Waterfowl: An important feeding area for *Pelecanus occidentalis, Phalacrocorax olivaceus* and Ardeidae from the breeding colony near Chitre Airport (site 11), and a very important area for passage and wintering shorebirds and Laridae. Common migrants include *Haematopus palliatus, Pluvialis squatarola, Charadrius semipalmatus, C. wilsonius, Limosa fedoa, Numenius phaeopus, Catoptrophorus semipalmatus, Actitis macularia, Arenaria interpres, Limnodromus griseus, Calidris alba, C. pusilla, C. mauri* (thousands), *C. minutilla, Himantopus himantopus, Larus atricilla, L. pipixcan, Chlidonias nigra* and *Sterna maxima*. A single *Pelecanus erythrorhynchos* was observed in the area in February 1984.

Other fauna: *Buteogallus anthracinus* is resident in the mangroves, and *Pandion haliaetus* and *Ceryle alcyon* occur in winter. Mammals include the Central American Otter *Lutra anectens, Procyon lotor* and *P. cancrivorus*; reptiles include *Crocodylus acutus* and *Ctenosaura similis.* There is a rich fish fauna including species of Lutjianidae, Carangidae, Ariidae and Centropomiidae.
Threats: There are no serious threats to the area. Recreation activities cause some disturbance to the birds, but this does not appear to be significant.
Research and conservation: Detailed studies have been carried out on the fauna and flora, and a shorebird banding programme has been initiated by ICBP Panama and the U.S. Fish and Wildlife Service. This work will be continued at the new biological station (Estacion Ecologica Alejandra von Humboldt), and special attention will be given to conservation education.
References: Delgado (1978, 1980b, 1980c, 1983 & in press).
Source: Francisco S. Delgado.
Criteria for inclusion: 3a.

Cenegon del Mangle and the Rio Santa Maria Estuary (14)

Location: 8°05'N, 80°30'W; 15 km NNW of Chitre, Herrera Province.
Area: 3,000 ha.
Altitude: 0-15m.
Province and type: 8.16.4; 02, 07 & 08.
Site description: A permanent brackish lagoon, up to 1.5m deep, with mangrove swamps; a seasonal brackish lagoon, up to 1m deep; and extensive brackish marshes and mangrove swamps in the estuary of the Rio Santa Maria. Salinities range from 10-35 p.p.t., and water levels in the lagoons fluctuate considerably according to rainfall, the shallower of the two drying out completely for three months in the dry season.
Principal vegetation: Mangrove swamps with *Avicennia germinans, Conocarpus erectus, Laguncularia racemosa, Mora* sp and *Rhizophora mangle*; woodland with *Prosopis* sp, *Caesalpinia* sp and *Arthocereus* sp. In the dry tropical forest zone.
Land tenure: Mainly state owned, with some concessions to private individuals for shrimp farming.
Protection: Part of the area has been protected in a Biological and Forest Reserve since 1980, and the entire area was declared a Wildlife Refuge in 1984.
Land use: Fishing, shrimp farming, livestock grazing and hunting; cultivation of beans in surrounding areas.
Waterfowl: An very important breeding, passage and wintering area for a wide variety of waterfowl, with one of the largest breeding colonies of Ardeidae in central Panama. The annual census of breeding birds in 1980 included 45 pairs of *Anhinga anhinga, 22 pairs of Cochlearius cochlearius, 1,600 pairs of Bubulcus ibis, 375 pairs of Egretta alba and 83 pairs of Eudocimus albus.* Other resident species include *Podiceps dominicus, Pelecanus occidentalis, Phalacrocorax olivaceus, Tigrisoma mexicanum, Egretta tricolor, Mycteria americana, Mesembrinibis cayennensis, Ajaia ajaja, Dendrocygna autumnalis, Cairina moschata, Oxyura dominica, Aramides axillaris, Jacana jacana, Vanellus chilensis* and *Himantopus himantopus.* Passage and wintering birds include *Ardea herodias, Anas discors*, many shorebirds and *Phaetusa simplex.*
Other fauna: *Pandion haliaetus* is a common winter visitor. Mammals include *Procyon lotor, P. cancrivorus* and *Agouti paca*; reptiles include *Crocodylus acutus, Ctenosaura similis* and *Boa constrictor.*
Threats: Mangroves have been destroyed for shrimp farming; there is some pollution from pesticide run-off; a proposal has been made to cut a channel between the permanent lagoon and the estuarine mangroves; and there is excessive disturbance from fishing activities and hunting.
Research and conservation: It is to be hoped that now the area has been included in a Wildlife Refuge, further habitat destruction can be prevented, illegal hunting and livestock grazing prohibited, and shrimp farming carefully controlled.
References: Delgado (1978, 1980d & 1983); Chang (1981b & 1981c).
Source: Francisco S. Delgado.
Criteria for inclusion: 2c & 3a.

Cienaga Las Macanas and Rio Santa Maria (15)

Location: 8°05'N, 80°32'W; 20 km northwest of Chitre, Herrera Province.
Area: 1,200 ha.
Altitude: 0-20m.
Province and type: 8.16.4; 09, 11, 12 & 16.
Site description: A slow-flowing river with riverine marshes; a permanent slightly brackish lake, up to 6m deep; extensive seasonal freshwater marshes; and surrounding seasonally flooded grassland. The salinity of the lake is 7 p.p.t.; it retains water throughout the dry season, but all the surrounding marshes dry out.
Principal vegetation: Beds of *Eichhornia crassipes* and *Pistia stratiotes* inthe lake; marshes with *Salvinia* sp and *Mimosa* sp; seasonally flooded grassland; and associations of Convolvulaceae and the spiny palm *Bactris* sp. In a region of dry tropical woodland with species of *Ceiba, Enterolobium, Guazouma, Anacardium, Erythrina* and *Prosopis*.
Land tenure: The lake is state owned; the marshes and surrounding areas are privately owned.
Protection: None.
Land use: Cattle ranching, pig farming, cultivation of rice and maize, and duck hunting.
Waterfowl: An important area for a wide variety of resident and migratory waterfowl, with almost the same species as Cenegon del Mangle (site 14). *Ardea cocoi* has been recorded, *Plegadis falcinellus* is an occasional visitor, and *Vanellus chilensis* occurs in small numbers in winter.
Other fauna: *Pandion haliaetus* is a common winter visitor. Mammals include the Central American Otter *Lutra anectens, Procyon lotor, P. cancrivorus, Agouti paca* and *Odocoileus virginianus*; reptiles include *Crocodylus acutus, Caiman crocodilus* and freshwater turtles of the genera *Kinosternon* and *Chrysemys*; fishes include species of Erythrinidae, Cichlidae, Curimatidae and Lutjianidae.
Threats: There is pollution with pesticide run-off from nearby rice and maize cultivation, and some disturbance from hunting. The main threat, however, is a proposal to drain the wetland for agricultural land.
Research and conservation: Some studies have been carried out on the fauna and flora, and a proposal has been made for the creation of a wildlife refuge.
References: Chang (1981d); Delgado (1983 & undated).
Source: Francisco S. Delgado.
Criteria for inclusion: 2b & 3a.

Cienaga de Paris (16)

Location: 8°05'N, 80°35'W; 20 km WNW of Chitre, Herrera Province.
Area: 3,000 ha.
Altitude: 10-20m.
Province and type: 8.16.4; 09, 11, 12 & 16.
Site description: A permanent freshwater lake, up to 6m deep, extensive seasonal freshwater marshes, and surrounding seasonally flooded grassland; connected by a system of canals to a nearby river. The marshes dry out completely during the dry season (December to March).
Principal vegetation: Marshes with species of *Nymphoides, Eichhornia, Salvinia* and *Pistia*; wet grassland with *Panicetum* sp, *Hyparrhenia rufa* and scattered *Erythrina glauca*.
Land tenure: Privately owned, by a number of landowners.
Protection: None.
Land use: Grazing by cattle and horses in the dry season, hunting (mainly for Columbidae), and cultivation of maize, sorghum and sugar cane.
Waterfowl: Apparently an important area for the same resident and migratory species as Cenegon del Mangle (site 14) and Cienaga Las Macanas (site 15), but complete data are lacking. *Dendrocygna autumnalis* and *Oxyura dominica* are known to breed.
Other fauna: *Pandion haliaetus* has been recorded in winter. Mammals include the Central American Otter *Lutra anectens, Agouti paca* and *Odocoileus virginianus*; reptiles include *Crocodylus acutus, Caiman crocodilus, Iguana iguana* and freshwater turtles of the genera *Kinosternon* and *Chrysemys*; fishes include species of Ariidae, Gobiidae, Curimatidae, Erythrinidae and Pimelodelidae.

Threats: There is pollution with pesticide run-off from nearby agricultural land, and considerable disturbance from hunting.
Research and conservation: Preliminary faunal and floral surveys have been carried out, but the area remains poorly known and further work is required.
References: Delgado (1983).
Source: Francisco S. Delgado.
Criteria for inclusion: 2b & 3a.

Aguadulce Salt Pans and El Salado Beach (17)

Location: 8°15'N, 80°30'W; 4 km east of Aguadulce, Cocle Province.
Area: 5,000 ha.
Altitude: 0–5m.
Province and type: 8.16.4/8.2.1; 02, 06, 07, 08 & 09.
Site description: A complex of salt pans, shrimp ponds, brackish to saline marshes, mangrove swamps, extensive intertidal mudflats and the estuaries of several small rivers. Salinities range from almost fresh in the marshes to 30 p.p.t. in the salt pans. Water levels fluctuate widely according to rainfall and tidal influence, and the salt pans and marshes dry out completely during the dry season.
Principal vegetation: Mangrove swamps with *Avicennia germinans, Conocarpus erectus, Laguncularia racemosa, Pelliciera rhizophorae, Mora* sp and *Rhizophora mangle*; sandy areas with *Coccoloba uvifera*; open woodland with species of *Prosopis, Caesalpinia* and *Arthrocereus.*
Land tenure: State owned, with some concessions for salt extraction and shrimp farming.
Protection: None.
Land use: Salt extraction, shrimp farming, fishing, duck hunting, and cutting of mangroves for timber and fuel. There is a harbour nearby for the exportation of sugar, and areas of rice cultivation inland.
Waterfowl: An important area for both resident and migratory waterfowl. Common residents include *Podilymbus podiceps, Podiceps dominicus, Pelecanus occidentalis*, many Ardeidae, *Eudocimus albus, Aramides cajanea, Porphyrula martinica, Jacana jacana* and *Himantopus himantopus. Tigrisoma mexicanum, Cochlearius cochlearius, Mycteria americana, Ajaia ajaja, Dendrocygna autumnalis, Cairina moschata, Oxyura dominica* and *Aramides axillaris* are resident in small numbers. Common passage migrants and winter visitors include *Ardea herodias, Anas acuta, A. discors* and many shorebirds and Laridae (the same species as at Playa El Agallito (site 13)).
Other fauna: *Pandion haliaetus* is a common winter visitor. Mammals include the Central American Otter *Lutra anectens, Procyon lotor, P. cancrivorus* and *Agouti paca*; reptiles include *Crocodylus acutus, Caiman crocodilus*, and freshwater turtles of the genera *Kinosternon* and *Chrysemys*. There is a rich fish fauna, and the area is noted for its high production of the commercially important shrimps *Peneus* sp and *Pseudopeneus* sp.
Threats: The principal threat is destruction of mangroves for salt pans, shrimp ponds and rice cultivation, and excessive cutting for timber and charcoal. There is some oil pollution from shipping at the nearby harbour, some industrial pollution, and pollution from pesticides used in the cultivation of sugar cane. *Phalacrocorax olivaceus* and Laridae are persecuted as predators on shrimps, and there is excessive shooting of Anatidae.
Research and conservation: A very important nursery ground for commercially important species of fishes and crustaceans, and one of the most important feeding areas for migratory shorebirds in the Gulf of Parita. Some preliminary investigations have been carried out, but the area clearly merits more detailed study.
References: Edwards & Loftin (1971); Loftin & Pujals (1976); Delgado (1983).
Source: Francisco S. Delgado.
Criteria for inclusion: 1a, 2c & 3a.

Rio Grande Marshes (18)

Location: 8°18'N, 80°44'W; 20 km ENE of Aguadulce, Cocle Province.
Area: 10,000 ha.
Altitude: 0-10m.
Province and type: 8.2.1; 02, 07, 08, 09 & 11.
Site description: Extensive riverine marshes along the lower Rio Grande and nearby Rio Chico; vast areas of mangrove swamps at the river mouths; and adjacent salt pans, shrimp ponds and brackish to saline marshes.
Principal vegetation: Mangrove swamps with *Avicennia germinans*, *Conocarpus erectus*, *Laguncularia racemosa*, *Pelliciera rhizophorae*, *Mora* sp and *Rhizophora mangle*; sandy areas with *Coccoloba uvifera*; open woodland with species of *Prosopis*, *Caesalpinia* and *Arthrocereus*.
Land tenure: The mangrove swamps and riverbanks are state owned; the salt pans and shrimp ponds are privately owned.
Protection: None.
Land use: Fishing, shrimp farming and salt extraction. Forestry, agriculture and cattle ranching in surrounding areas.
Waterfowl: An important breeding area for waterfowl, with a large colony of Ardeidae and Threskiornithidae and the only breeding colony of *Ajaia ajaja* in Panama. *Cairina moschata* is also known to breed. Presumably also important for passage and wintering waterfowl, but no data are available.
Other fauna: Similar to Aguadulce salt pans (site 17).
Threats: Drainage of the marshes for ranching and agriculture; destruction of the mangroves for shrimp ponds and salt pans; pollution from pesticides; and excessive hunting.
References: Delgado (1983).
Source: Francisco S. Delgado.
Criteria for inclusion: 2b & 3a.

Gatun Lake (19)

Location: 9°10'N, 79°50'W; part of the Panama Canal, Panama and Colon Provinces.
Area: 32,000 ha.
Altitude: 36m.
Province and type: 8.2.1; 09, 12, 15 & 18.
Site description: A large artificial freshwater lake, up to 60m deep, created in 1912-1914 between two locks in the Panama Canal. The water supply comes from the Chagres River and Lago Alajuela in the northeast, and many small forest streams. There are numerous forested islands including Barro Colorado, shallow bays with extensive marshes, small lakes in surrounding swamps, and areas of swamp forest. The salinity varies from 0-7 p.p.t., and the water level is controlled by the locks and a spillway at the northwest end of the lake.
Principal vegetation: Extensive swamps with species of *Typha*, *Eichhornia*, *Pistia* and *Hydrilla*. Most of the lake is surrounded by relatively unspoiled humid tropical forest.
Land tenure: Partly within the Panama Canal Defense Zone, under joint Panama/U.S.A. administration until the year 2000; partly state owned; and partly privately owned. Much of the shoreline is within state owned parks and forest reserves.
Protection: Barro Colorado Island (5,400 ha) is protected as a Natural Monument, established in 1924. Much of the shoreline is protected in the Madden Forest Reserve, Soberania National Park and Chagres National Park; other areas are unprotected.
Land use: The lake forms part of the Panama Ship Canal. It is also used for sport fishing, sailing and other water sports, and the production of hydroelectricity, and provides a water supply for the cities of Panama and Colon. Numerous canal maintenance boats and helicopters patrol the lake, there is a railroad along its eastern shore, and parts of the area are used for military excercises. There is some forest exploitation along unprotected shores. Barro Colorado Island is a major biological research station administered by the Smithsonian Institution.

Waterfowl: An important area for breeding, passage and wintering waterfowl of a wide variety of species. Resident species include *Podilymbus podiceps, Podiceps dominicus, Pelecanus occidentalis, Phalacrocorax olivaceus, Anhinga anhinga,* many Ardeidae (notably *Ixobrychus exilis, Tigrisoma lineatum, Pilherodius pileatus* and *Agamia agami*), *Mycteria americana, Mesembrinibis cayennensis, Ajaia ajaja, Oxyura dominica, Aramus guarauna, Aramides cajanea, Laterallus albigularis, Porphyrula martinica, Heliornis fulica, Eurypyga helias* and *Jacana jacana.* Passage migrants and winter visitors include *Ardea herodias, Plegadis falcinellus, Anas americana, A. acuta, A. discors, A. clypeata, Aythya affinis, Fulica americana,* many shorebirds, *Larus atricilla, Chlidonias nigra, Gelochelidon nilotica, Sterna hirundo* and *Sterna albifrons.*

Other fauna: *Pandion haliaetus* is a common winter visitor. The region supports a very rich avifauna; over 360 species have been recorded from Soberania National Park on the east shore of the lake. Other groups are similarly well represented. Mammals include *Hydrochoerus hydrochaeris, Agouti paca, Lutra anectens* and *Tapirus bairdii*, and the manatee *Trichechus manatus* has been introduced. Reptiles include two crocodilians and several freshwater turtles. The native fish fauna has, however, become impoverished as a result of the introduction of exotic species, notably Cichlidae, for sport fishing.

Threats: Destruction of forests in surrounding areas and the resulting soil erosion are causing increased siltation, which has necessitated increased dredging and other maintenance activities in the canal. These activities, together with the passage of shipping, military excercises and recreation, cause a considerable amount of disturbance to wildlife. The spread of *Eichhornia, Pistia* and *Hydrilla* can become a problem to shipping, and is controlled with herbicides. There is some pollution from shipping and some illegal hunting, but neither appear to be a problem. A proposal has been made for the construction of a new canal at sea level; this would have tremendous repercussions not only on the existing freshwater lake systems, but also on the marine ecosystems at either side of the isthmus. The implementation of this project is still under debate.

Research and conservation: The fauna and flora of the lake and surrounding forests have been well documented and indeed the forest on Barro Colorado Island is the most intensively studied tropical forest in the world. The Torrijos-Carter Treaty provides in general for the conservation of the lake and surrounding forests, but enforcement of the regulations has been inadequate and must be improved.

References: Eisenmann (1952); Woodring (1958); Rubinoff (1970); Edwards & Loftin (1971); Eisenmann & Loftin (1972a); Zaret & Paine (1973); Knight (1975); Briggs (1977); Willis & Eisenmann (1979); IUCN (1982); Comision del Canal de Panama (1983); Delgado (1983); Myers & Rand (undated). In addition, there are hundreds of scientific papers on tropical forest ecology emanating from the biological research station on Barro Colorado Island.

Source: Francisco S. Delgado.

Criteria for inclusion: 2b & 3a.

Bay of Panama (20)

Location: 8°35'N, 78°30'W to 9°00'N, 79°30'W; on the Pacific coast from Panama City east for 130 km.

Area: 38,500 ha.

Altitude: 0m.

Province and type: 8.2.1; 01, 02, 05, 06, 07 & 08.

Site description: A broad continuous strip of intertidal mudflats, sand flats, mangrove swamps and brackish marshes along 130 km of coastline from the southern entrance to the Panama Canal to Punta Brujas, including the estuaries of the Rio Chepo and several smaller rivers. The tides range from 3-5m. During the dry season (January to mid April), upwelling of nutrient-rich waters in the bay supports high primary productivity. The formerly important marshes at Tocumen Lagoon in the west have been much reduced in size by drainage for agriculture.

Principal vegetation: Mangrove swamps.

Land tenure: The mangrove swamps and beaches are state owned; inland areas are privately owned.

Protection: None.

Land use: Fishing; hunting, agriculture, cattle ranching and forestry inland, particularly in the west.
Waterfowl: One of the most important wintering areas for Nearctic shorebirds in the Neotropics, with densities amongst the highest recorded anywhere. The total population probably numbers in the millions. The commonest species are *Pluvialis squatarola, Charadrius semipalmatus, C. wilsonius, Numenius phaeopus, Catoptrophorus semipalmatus, Arenaria interpres, Limnodromus griseus, Calidris pusilla, C. mauri* and *C. minutilla.* The concentrations of *C. mauri* are particularly significant, and may constitute as much as half the world population of the species. The bay is also an important feeding area for *Pelecanus occidentalis*, Ardeidae, *Himantopus himantopus* and Laridae.
Other fauna: *Pandion haliaetus* is a common winter visitor. Mammals include the Central American Otter *Lutra anectens, Procyon lotor, P. cancrivorus, Agouti paca* and *Hydrochoerus hydrochaeris*; reptiles include *Crocodylus acutus, Caiman crocodilus* and freshwater turtles of the genera *Kinosternon* and *Chrysemys.* There is a rich fish fauna, and the area is noted for its high production of the commercially important shrimps *Peneus* sp and *Pseudopeneus* sp.
Threats: Coastal marshes in the west are threatened by drainage for agriculture and pollution.
Research and conservation: Some studies have been conducted on shorebirds near the mouth of the Panama Canal, but the area as a whole has been much neglected and clearly merits further investigation.
References: Mallory (1982); Schneider & Mallory (1982); Delgado (1983).
Source: Francisco S. Delgado, Brian A. Harrington and Robert S. Ridgely.
Criteria for inclusion: 1a, 1c & 3a.

Lago Bayano (21)

Location: 9°05'N, 78°40'W; 75 km east of Panama City, Chepo District.
Area: 30,000 ha.
Altitude: 62m.
Province and type: 8.2.1; 15 & 18.
Site description: A recently completed hydroelectric dam 50 km long and with a very indented shoreline, in flooded forest in the valley of the Rio Chepo, north of the Serrania de Cañazas.
Principal vegetation: Beds of *Pistia stratiotes* are spreading across the lake; in a region of humid tropical forest.
Land tenure: No information.
Protection: None.
Land use: The production of hydroelectricity. Forestry, agriculture and cattle ranching in surrounding areas.
Waterfowl: The dam is rapidly becoming an important site for waterfowl, and breeding colonies of *Phalacrocorax olivaceus, Anhinga anhinga* and Ardeidae have become established.
Other fauna: No information.
Threats: The spread of *Pistia stratiotes* may eventually reduce the value of the dam for waterfowl.
References: Delgado (1983).
Source: See references.
Criteria for inclusion: 3a.

Rio Sabana, Rio Chucunaque, Rio Tuira and Rio Sambu (22)

Location: 8°04'-8°36'N, 77°21'-78°23'W; on the Pacific coast of Darien Province.
Area: c.433,000 ha.
Altitude: 0-10m.
Province and type: 8.2.1; 02, 06, 08, 09, 11, 12 & 18.
Site description: The floodplains and estuarine systems of the Sabana, Chucunaque, Congo, Tuira-Matusagarati, Platanal and Sambu Rivers; a vast complex of slow-flowing rivers, riverine marshes, permanent and seasonal freshwater lakes and marshes, swamp forest and

mangrove swamps, with extensive intertidal mudflats at the river mouths and along adjacent coasts. The tides range from 3.8-6.1m. and affect the Tuira and Chucunaque Rivers for many kilometres inland.

Principal vegetation: Swamp forest dominated by stands of *Priorea copaifera*; mangrove swamps with *Avicennia germinans, Laguncularia racemosa, Rhizophora mangle, Mora oleifera* and *Pterocarpus officinalis*. In a region of very humid tropical forest.

Land tenure: About 90% state owned; the remainder is owned by local Indian communities.

Protection: Within the Darien National Park (597,000 ha) established in 1979. The National Park is a World Heritage Site established 1981, and 575,000 ha were designated a Biosphere Reserve in 1983.

Land use: A little traditional agriculture by the Chocoe and Cuna Indians, and some fishing and forestry. Most of the area is still relatively undisturbed.

Waterfowl: Known to be very rich in waterfowl with several species which are rare elsewhere in Panama, but little information is available. Species known to occur include *Agamia agami, Eudocimus albus, Sarkidiornis melanotos* and *Aramus guarauna*.

Other fauna: Mammals include *Hydrochoerus hydrochaeris* and *Tapirus bairdii*; reptiles include *Crocodylus acutus* and *Caiman crocodilus*.

Threats: There is some illegal encroachment by settlers in the Park, and some exploitation of forests and illegal hunting. The completion of the Panamerican Highway through to Colombia would open up the area to development, but work on the highway has apparently been suspended.

Research and conservation: The National Park contains some of the most diverse tropical forests known. A management plan has been prepared, but to date very little work has been conducted on the fauna and flora.

References: Dalfelt & Morales (1978); IUCN (1982); Delgado (1983 & in press).

Source: See references.

Criteria for inclusion: 2b & 3a.

COUNTRY REPORTS

Caribbean

ANGUILLA

INTRODUCTION

Little information was received on the current situation in Anguilla. The following account is based on material provided by Edouard Benito-Espinal and the literature, principally Towle (1979), Putney (1982) and Goodwin *et al* (1984).

Anguilla is a low-lying limestone island with several small offshore islets, situated in the northern Leeward Islands of the Lesser Antilles, 8 km north of Saint Martin. It has an area of about 90 km^2 and a maximum elevation of about 65m. Formerly associated with St. Kitts and Nevis, Anguilla seceded in 1969 and is now a Dependent Territory of the United Kingdom; it has a population of about 8,000.

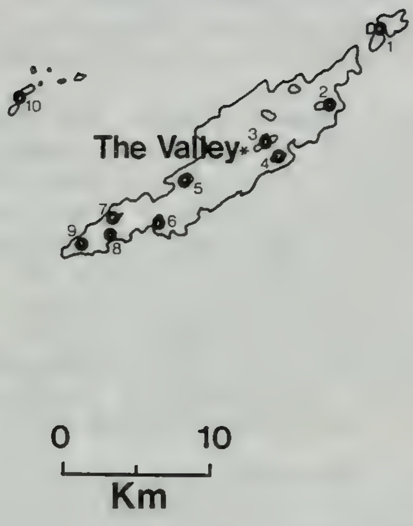
The island lies in the Northeast Trade Winds, and has a dry tropical climate. The average annual rainfall is about 1,000 mm, almost half of this falling in the wet season from August to November. The predominant natural vegetation is dry woodland and scrub with some cacti, but most of this has now been modified by shifting agriculture and grazing, or lost to urban development. The island has about fifteen saline ponds and many small mangroves swamps of considerable importance for both resident and migratory waterfowl, but there are no freshwater wetlands of any significance. There are many sandy beaches with nesting sea turtles, several islets with breeding colonies of sea-birds, and extensive offshore coral reefs.

Waterfowl recorded by Edouard Benito-Espinal during a brief survey of five saline ponds in November 1984 included *Pelecanus occidentalis, Nyctanassa violacea, Bubulcus ibis, Egretta thula, E. alba, Anas bahamensis, A. discors, Porzana carolina, Himantopus himantopus* and over 650 Nearctic shorebirds of eleven species.

The Ministry of Tourism and Natural Resources is responsible for environmental conservation in the island. Considerable attention is being given to the establishment of a system of marine parks to combat the depletion of coral reef fauna and marine species caused by heavy commercial fishing and spear fishing, but little interest has been shown in the preservation of terrestrial systems. According to Putney (1982), no protected areas had been established prior to 1982, but five areas had been proposed for protection. Only one of these, a reserve in the Prickly Pear Cays, included any wetland habitat.

Many of the island's salt ponds offer potential as part of an expanded salt industry, or for the culture of brine shrimps (*Artemia* sp), and a study has been conducted in relation to the latter (Goodwin *et al*, 1984). However, some of the smaller ponds are being used for the disposal of solid waste, several ponds are under pressure from the development of nearby tourist resorts, and at least one pond is being considered for the development of a marina. In addition, the government permits dredging of sand at three ponds for construction purposes, this being regarded locally as a conservationist policy, since sand was previously mined from the beaches.

ANGUILLA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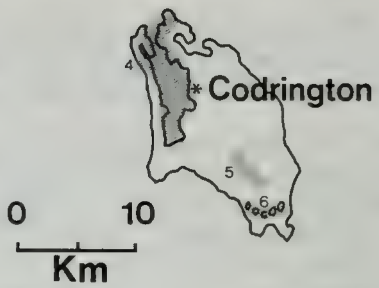
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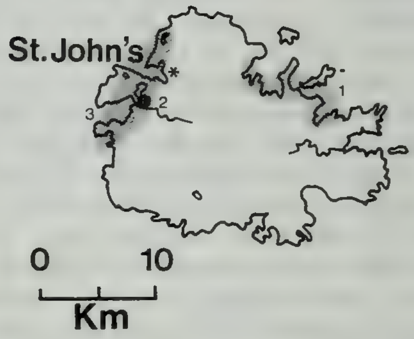
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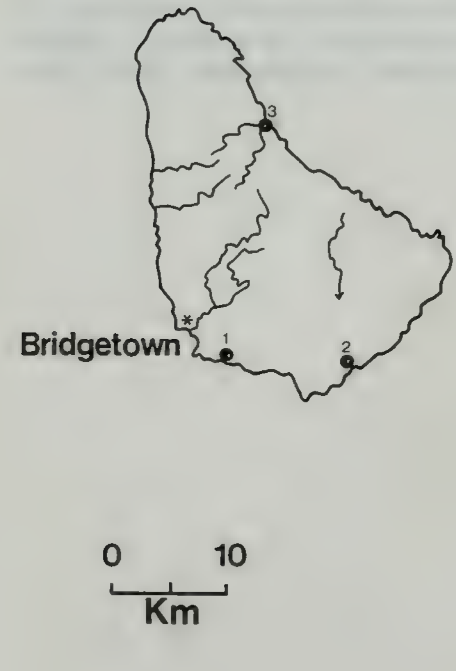
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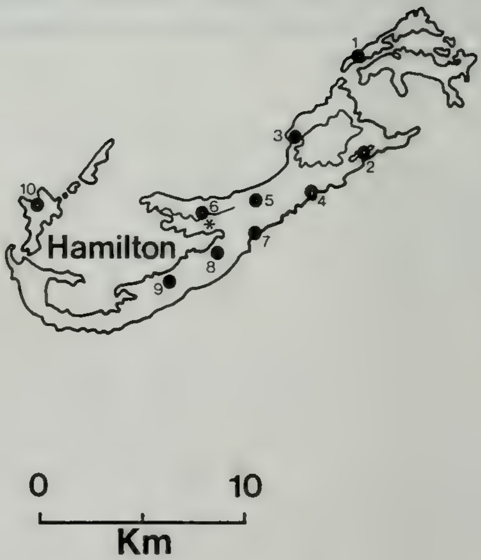
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WETLANDS

Site descriptions based on Towle (1979), Putney (1982), Goodwin *et al* (1984) and some waterfowl counts made by Edouard Benito-Espinal in November 1984.

Wetlands on Scrub Island (1)

Location: 18°17'N, 62°57'W; on Scrub Island, off the eastern tip of Anguilla.
Area: c.30 ha.
Altitude: Near sea level.
Province and type: 8.41.13; 05, 07 & 08.
Site description: Three small salt ponds with some associated mangrove swamps and adjacent sand beaches.
Principal vegetation: Mangroves; cactus scrub in surrounding areas.
Land tenure: Privately owned.
Protection: None.
Land use: None, other than a little tourism.
Waterfowl: An important area for Ardeidae, Anatidae and migratory shorebirds.
Other fauna: There are some coral reefs offshore.
Threats: None known.
References: Putney (1982).
Source: See references.
Criteria for inclusion: 0.

Savannah Pond (2)

Location: 18°15'N, 62°59'W; near Savannah Bay, at the east end of Anguilla.
Area: 20 ha.
Altitude: Near sea level.
Province and type: 8.41.13; 05, 07 & 08.
Site description: A small saline lagoon, up to 70 cm deep, with fringing mangrove swamps; behind the sandy beaches of Savannah Bay. Salinities of 81-87 p.p.t. were recorded in December 1983.
Principal vegetation: Mangroves; low scrub in surrounding areas.
Land tenure: Privately owned.
Protection: None.
Land use: Some tourist development to the west, and livestock grazing to the south. The area is sparsely populated and little disturbed.
Waterfowl: An important area for Ardeidae, including *Nyctanassa violacea*, passage *Anas discors*, migratory shorebirds and *Himantopus himantopus*.
Other fauna: There are extensive coral reefs in Savannah Bay.
Threats: None known. The nearby Mt. Fortune Pond is being filled.
References: Putney (1982); Goodwin *et al* (1984).
Source: Edouard Benito-Espinal.
Criteria for inclusion: 3a.

Cauls Pond (3)

Location: 18°13'N, 63°02'W; in the centre of the island, 4 km east of Crocus Bay.
Area: 60 ha.
Altitude: Near sea level.
Province and type: 8.41.13; 07 & 08.
Site description: A large saline lagoon with fringing mangrove swamps; the largest lagoon on Anguilla.

Principal vegetation: Mangroves; cactus scrub in surrounding areas.
Land tenure: Privately owned.
Protection: None.
Land use: Some grazing of domestic livestock in surrounding areas.
Waterfowl: An important area for Ardeidae, Anatidae and migratory shorebirds.
Other fauna: No information.
Threats: No information.
Research and conservation: Identified by Putney as one of the largest saline lagoons in relatively unaltered condition in the Lesser Antilles.
References: Putney (1982).
Source: See references.
Criteria for inclusion: 3a.

Long Salt Pond (4)

Location: 18°13'N, 63°01'W; near Sandy Hill Bay on the south coast.
Area: 23 ha.
Altitude: Near sea level.
Province and type: 8.41.13; 05, 07 & 08.
Site description: A saline lagoon, less than 50 cm deep, with brackish marshes and some mangroves to the west, and sandy beaches to the east. Salinities of 110-112 p.p.t. were recorded in December 1983.
Principal vegetation: Mangroves and brackish marshes; low scrub and dune vegetation in surrounding areas.
Land tenure: Privately owned.
Protection: None.
Land use: Formerly used for salt production and shrimp farming. There is some grazing in surrounding areas and urban development nearby.
Waterfowl: An important area for Ardeidae and migratory shorebirds.
Other fauna: The brine shrimp *Artemia* sp occurs.
Threats: None known.
References: Putney (1982); Goodwin *et al* (1984).
Source: See references.
Criteria for inclusion: 0.

Road Salt Pond (5)

Location: 18°12'N, 63°06'W; near Road Bay, on the north shore of the island.
Area: 45 ha.
Altitude: Near sea level.
Province and type: 8.41.13; 07.
Site description: A saline lagoon, up to 1m deep, with muddy shoreline, behind a sea beach. An intake ditch is opened once yearly to allow sea water to enter for salt production, and a diked trench encircles the pond to prevent rainwater run-off from entering.
Principal vegetation: Cactus scrub and dry woodland in surrounding areas.
Land tenure: The pond is state owned and leased for salt production; surrounding areas are privately owned.
Protection: None.
Land use: Salt production. There is some grazing in surrounding areas, and urban and tourist development nearby.
Waterfowl: An important area for Ardeidae and migratory shorebirds. About 200 shorebirds were present in November 1984, mainly *Tringa flavipes, Arenaria interpres, Calidris pusilla* and *Micropalama himantopus.*
Other fauna: The brine shrimp *Artemia* sp occurs.

Threats: The pond has been greatly modified for salt production, and is being encroached upon by a nearby residential area.
References: Putney (1982); Goodwin *et al* (1984).
Source: Edouard Benito-Espinal.
Criteria for inclusion: 3a.

Rendezvous Pond (6)

Location: 18°11'N, 63°07'W; at Rendezvous Bay, on the south coast.
Area: 25 ha.
Altitude: 0m.
Province and type: 8.41.13; 05, 07 & 08.
Site description: A saline lagoon, up to 40 cm deep, with fringing mangroves, behind a sea beach. The pond dries out periodically. A salinity of 131 p.p.t. was recorded in December 1983.
Principal vegetation: Mangroves; dry scrub in surrounding areas.
Land tenure: The pond is state owned; surrounding areas are privately owned.
Protection: None.
Land use: Tourism along the coast. The pond was once leased from the government for salt production.
Waterfowl: An important area for Ardeidae, Anatidae and migratory shorebirds.
Other fauna: No information.
Threats: Residential development is taking place to the north of the pond.
References: Putney (1982); Goodwin *et al* (1984).
Source: See references.
Criteria for inclusion: 0.

Meads Bay Pond (7)

Location: 18°11'N, 63°08'W; at Meads Bay, on the north coast.
Area: 20 ha.
Altitude: 0m.
Province and type: 8.41.13; 05, 07 & 08.
Site description: A saline lagoon over 1m deep, with fringing mangroves and adjacent sandy beach. Run-off from nearby hills enters through a culvert. Salinities of 100-116 p.p.t. were recorded in December 1983.
Principal vegetation: Mangroves; dry scrub inland and sea-grass beds offshore.
Land tenure: The pond is state owned; surrounding areas are privately owned.
Protection: None.
Land use: Sand mining; tourism along the coast and urban development inland.
Waterfowl: An important area for Ardeidae and migratory shorebirds.
Other fauna: The brine shrimp *Artemia* sp occurs.
Threats: Sand is being dredged from the pond for resort construction.
References: Putney (1982); Goodwin *et al* (1984).
Source: See references.
Criteria for inclusion: 0.

Cove Pond (8)

Location: 18°11'N, 63°09'W; at Cove Bay, on the southwest coast.
Area: 75 ha.
Altitude: 0m.
Province and type: 8.41.13; 05, 07 & 08.

Site description: A saline lagoon over 4m deep, with fringing mangroves and an adjacent sandy beach. Salinities of 125-130 p.p.t. were recorded in December 1983.
Principal vegetation: Mangroves; low woodland and scrub to the north.
Land tenure: The pond and land to the north are state owned; the adjacent coast is privately owned.
Protection: None.
Land use: Sand mining; tourism along the coast.
Waterfowl: An important area for Ardeidae and migratory shorebirds. 160 shorebirds were present in November 1984, mainly *Tringa flavipes, Arenaria interpres, Calidris pusilla, Micropalama himantopus* and *Himantopus himantopus*. *Anas bahamensis* also occurs.
Other fauna: No information.
Threats: Sand is being dredged from the pond for construction purposes, tourist resorts are being developed to the east and southeast, and the Government is considering the site for the development of a marina.
References: Putney (1982); Goodwin *et al* (1984).
k06H**Source:** Edouard Benito-Espinal.
Criteria for inclusion: 3a.

West End Salt Pond (9)

Location: 18°10'N, 63°10'W; near the western tip of the island.
Area: 18 ha.
Altitude: Near sea level.
Province and type: 8.41.13; 05, 07 & 08.
Site description: A saline lagoon, less than 1m deep, with fringing mangroves; behind a sea beach. A dike on the west shore retards infiltration from a nearby fresh water spring, and remnants of a sea water control system used in salt production still exist. Salinities of 134-138 p.p.t. were recorded in December 1983.
Principal vegetation: Mangroves; low forest and scrub in surrounding areas.
Land tenure: Privately owned.
Protection: None.
Land use: The pond was used for salt production until 1976, and more recently, an aquaculture project for lobsters was established, but this is no longer in operation. There is tourism along the coast.
Waterfowl: An important feeding area for Ardeidae and migratory shorebirds. Over 280 shorebirds were present in November 1984, mainly *Tringa flavipes, Arenaria interpres* and *Calidris pusilla*.
Other fauna: The brine shrimp *Artemia* sp occurs.
Threats: No information.
References: Putney (1982); Goodwin *et al* (1984).
Source: Edouard Benito-Espinal.
Criteria for inclusion: 3a.

Wetlands on Dog Island (10)

Location: 18°17'N, 63°15'W; on Dog Island, 15 km northwest of the western tip of Anguilla.
Area: c.10 ha.
Altitude: Near sea level.
Province and type: 8.41.13; 05 & 07.
Site description: Two small saline lagoons with adjacent sandy beaches.
Principal vegetation: Dry scrub in surrounding areas.
Land tenure: Privately owned.
Protection: None.
Land use: None; the island is uninhabited.
Waterfowl: An important area for Ardeidae, Anatidae and migratory shorebirds.

Other fauna: Sea turtles use the beaches for nesting and there are important sea-bird colonies on several tiny offshore islets.
Threats: Negotiations have taken place between the Anguilla Government and the U.S. Navy for the possible use of the island as a gunnery and bombing range.
References: Towle (1979); Putney (1982).
Source: See references.
Criteria for inclusion: 3a.

ANTIGUA AND BARBUDA

INTRODUCTION

No information was received on the current situation in Antigua and Barbuda. The following account is based on Stoddart *et al* (1973), IUCN (1982) and Putney (1982).

Antigua and its two dependencies Barbuda and Redonda lie in the Leeward Islands of the Lesser Antilles, to the north of Guadeloupe and to the east of Saint Kitts-Nevis. Antigua, with an area of 280 km^2, is the largest of the group. It is a limestone and volcanic islandrising to over 400m in the southwest. Barbuda is a low-lying island of pleistocene and recent limestones, 45 km north of Antigua. Of its total area of 161 km^2, about 20% is occupied by shallow lagoons and mudflats. Redonda is an uninhabited rocky islet 50 km to the west of Antigua, between Nevis and Montserrat. Antigua became independent in 1981 and has a population of about 72,000 with an economy based on agriculture, light industry and tourism. Barbuda remains almost undeveloped; the population is less than 1,000 and most of these live in the only village on the island.

The islands lie in the Northeast Trades and have a rather dry tropical climate, with mean annual temperatures of approximately 27°C and an average annual rainfall of less than 1,000 mm. The predominant native vegetation is dry evergreen woodland and cactus scrub, but this has been much altered by human activities, particularly on Antigua. Both main islands are rich in wetlands, mainly brackish to saline lagoons and mangrove swamps, and Barbuda is particularly noted for the abundance of its wildlife. There are many sandy beaches with nesting sea turtles around both islands; extensive offshore coral reefs and sea-grass beds, particularly around Barbuda; and several islets with sea-bird colonies off the east coast of Antigua.

The Ministry of Agriculture and Supply (formerly the Ministry of Agriculture, Lands and Fisheries) has official responsibility for conservation in the islands. The Marine Parks Act of 1972 provides the legal basis for the establishment of Marine Parks which are administered by the Fisheries Department. The Antigua National Trust Act, also of 1972, has provision for the setting up of parks, reserves and monuments. There is no office in the Government specifically responsible for matters relating to wetlands or laterfowl. Only three protected areas had been established by 1981; two marine parks protecting offshore coral reefs, and a reserve at Cape Shirley in southern Antigua. None of these contains wetlands. However, of the areas under consideration for protection in 1981, two incorporated wetlands; a proposed reserve on Barbuda including the whole of Codrington Lagoon and mangrove swamps to the northwest, and a proposed reserve on Antigua including Guiana Island, with some mangrove swamps at the west end and nearby islets with sea-bird colonies.

WETLANDS

No recent information is available on the wetlands of Antigua and Barbuda. Descriptions of the six main wetland areas are based almost entirely on Stoddart *et al* (1973), Putney (1982) and Goodwin *et al* (1984). Other wetlands, probably of only local importance, include several saline ponds and about ten small patches of mangroves in bays along the southern coast of Antigua, and mangrove swamps and associated marshes in Cobb Cove, on the northeast coast of Barbuda. (For map, see Anguilla.)

Parham Harbour and Guiana Bay (1)

Location: 17°07'N, 61°45'W; on the northeast coast of Antigua.
Area: 600 ha.
Altitude: 0m.
Province and type: 8.41.13; 01, 03, 06, 07 & 08.
Site description: A chain of mangrove swamps, brackish to saline marshes and coastal mudflats around a series of shallow sea bays (Parham Harbour, Guiana Bay and Mercer's Creek Bay), and several small offshore islands with some mangroves.
Principal vegetation: Mangrove swamps with *Laguncularia racemosa* and *Conocarpus erectus*, and brackish to saline marshes with *Batis maritima*, *Sesuvium portulacastrum*, *Sporobolus virginicus*, *Heliotropium curassavicum*, *Philloxerus vermicularis*, *Egletes prostrata*, *Bacopa monnieri* and *Eleocharis geniculata*; sea-grass beds offshore, and dry woodland and cactus scrub inland.
Land tenure: A mixture of public and private ownership.
Protection: None.
Land use: Most of the area is relatively undisturbed; there are some small settlements in the vicinity, and a tanker terminal and oil pipeline on the Parham Peninsula.
Waterfowl: No information.
Other fauna: There are sea-bird colonies and sea-turtle nesting areas on islands in Guiana Bay and Mercer's Creek Bay.
Threats: Domestic pollution and pollution from the tanker terminal on Parham Harbour.
Research and conservation: Identified by Putney as one of the largest remaining stands of relatively unaltered mangroves in the Lesser Antilles. A proposal has been made for the creation of a protected area incorporating the islands in Guiana Bay; this would include a small patch of mangroves at the west end of Guiana Island.
References: Putney (1982); Portecop & Benito-Espinal (1984a).
Source: See references.
Criteria for inclusion: 3a.

Five Island Harbour (2)

Location: 17°06'N, 61°53'W; south of Five Islands on the west coast of Antigua.
Area: c.200 ha.
Altitude: 0m.
Province and type: 8.41.13; 01, 07 & 08.
Site description: Mangrove swamps and associated brackish to saline marshes by a sea bay.
Principal vegetation: Mangroves; cactus scrub inland.
Land tenure: Privately owned.
Protection: None.
Land use: Grazing of domestic livestock nearby.
Waterfowl: No information.
Other fauna: No information.
Threats: Pollution from industrial and domestic waste from urban areas to the east.
References: Putney (1982).
Source: See references.
Criteria for inclusion: 0.

Salt Ponds of western Antigua (3)

Location: 17°07'N, 61°53'W; along the west coast of Antigua.
Area: 201 ha (seven ponds).
Altitude: 0m.
Province and type: 8.41.13; 05, 07 & 08.
Site description: Seven saline ponds along the west coast of Antigua from Runaway Bay in the north to Lignumvitae Bay in the south.

McKinnon's Pond: 40 ha; a large salt pond up to 50 cm deep with some mangrove swamps, behind a sea beach. The pond dries out completely in exceptionally dry years. The sea beach occasionally breaches during storms allowing the ingress of sea water.

Cocks Hill Pond: 10 ha; an enclosed salt pond behind a sea beach.

Jolly Hill Pond: 100 ha; an enclosed salt pond less than 1m deep with surrounding brackish marshes. The pond dries out completely during dry periods.

Deep Bay Pond: 18 ha; an enclosed salt pond 1-2m deep, behind a sea beach. The pond is currently being dredged.

York's Pond: 13 ha; a salt pond with mangrove swamps, behind a sea beach; formerly enclosed but now open to the sea via a channel dredged by local residents.

Pinching Bay Pond: 12 ha; a small coastal lagoon with mangrove swamps, connected to the sea by a narrow channel.

Galley Bay Pond: 8 ha; an enclosed salt pond with dense stands of mangroves, behind a sea beach.

A salinity of 236 p.p.t. was recorded at Deep Bay Pond in December 1983; salinities at five of the other ponds ponds ranged from 36 to 53 p.p.t.
Principal vegetation: Mangrove swamps with *Avicennia germinans* and some *Laguncularia racemosa* at McKinnon's, York's, Pinching Bay and Galley Bay Ponds, and brackish marshes at Jolly Hill Pond; cactus scrub, low forest and some grassland in surrounding areas.
Land tenure: Mostly privately owned.
Protection: None.
Land use: Solid waste disposal at Cocks Hill Pond, marina development at McKinnon's and Deep Bay Ponds, and livestock grazing around Jolly Hill Pond. There are numerous tourist resorts in the area, several immediately adjacent to ponds, and there is intensive recreation on nearby beaches.
Waterfowl: A very important group of ponds for migratory shorebirds, particularly during the autumn passage when flocks of up to 2,000 *Calidris pusilla* have been observed (Maurice B. Hutt, pers. com.).
Other fauna: Marine fishes have invaded York's Pond since it was opened to the sea, and occasionally enter McKinnon's Pond during storms. The brine shrimp *Artemia* sp occurs in Deep Bay Pond.
Threats: Of the seven ponds, only Pinching Bay Pond remains undisturbed and under no immediate threat. McKinnon's Pond has been committed by the Government for the development of a marina, and an oil refinery to the east has caused some pollution. Cocks Hill Pond is used as a rubbish dump and is badly polluted. Jolly Hill Pond is likely to be filled by the development company which owns it. Deep Bay Pond and the surrounding land are being developed into a marina and resort area; a channel was dredged from the pond to the nearby beach in 1983 and this is likely to be opened to the sea. York's Pond has already been connected to the sea by a channel, and now constitutes a sea water pond. A resort hotel on the northwest shore of Galley Bay Pond causes some disturbance there.
Research and conservation: Jolly Hill Pond has been identified by Putney as one of the largest remaining natural salt ponds in relatively unaltered condition in the Lesser Antilles. It seems likely, however, that this pond will be completely destroyed in the near future.
References: Putney (1982); Goodwin *et al* (1984).
Source: See references.
Criteria for inclusion: 3a.

Codrington Lagoon (4)

Location: 17°40'N, 61°51'W; in north and west Barbuda.
Area: 3,550 ha.
Altitude: 0m.
Province and type: 8.41.13; 05, 07 & 08.
Site description: A large saline lagoon of 2,650 ha, separated from the sea by a sand barrier and with a narrow connection to the sea at its north end; there are several small islands in the lagoon, about 900 ha of mangrove swamps, particularly in the north, and associated brackish to saline marshes.
Principal vegetation: Mangrove swamps with *Laguncularia racemosa, Conocarpus erectus* and *Rhizophora mangle*; beds of *Batis maritima*; brackish to saline marshes with *Sesuvium portulacastrum, Sporobolus virginicus, Salicornia perrenis, Borrichia arborescens* and *Heliotropium curassavicum*; cactus scrub in surrounding areas.
Land tenure: Almost entirely public land (state owned).
Protection: None.
Land use: The small settlement of Codrington lies on the east shore of the lagoon; otherwise the area is little disturbed.
Waterfowl: The area is known to be very rich in waterfowl, particularly Ardeidae, migratory shorebirds and Laridae, but no details are available.
Other fauna: There is a breeding colony of *Fregata magnificens* in the mangroves. Sea turtles nest on the adjacent beaches, and there is an important lobster fishery in the lagoon.
Threats: A little pollution from domestic waste from Codrington settlement.
Research and conservation: The mangrove swamps constitute one of the largest remaining stands of relatively unspoiled mangroves in the Lesser Antilles. The entire lagoon and mangrove swamps to the northwest have been proposed as protected areas.
References: Stoddart *et al* (1973); Putney (1982); Portecop & Benito-Espinal (1984a).
Source: See references.
Criteria for inclusion: 3a.

Bull Hole and inland mangroves of Barbuda (5)

Location: 17°35'N, 61°46'W; in south-central Barbuda.
Area: 200 ha.
Altitude: Near sea level.
Province and type: 8.41.13; 07 & 08.
Site description: A complex of permanent and seasonal brackish pools with extensive mangrove swamps completely isolated from the sea, and some surrounding mudflats and brackish marshes.
Principal vegetation: Mangroves, principally *Laguncularia racemosa* and *Conocarpus erectus*, with some stands of *Rhizophora mangle*; mudflats with patchy cover of *Sesuvium portulacastrum, Sporobolus virginicus* and *Heliotropium curassavicum*; and sedge marshes with *Fimbristylis ferruginea* and *Eleocharis cellulosa.* Cactus scrub in surrounding areas.
Land tenure: Public land (state owned).
Protection: None.
Land use: Some grazing of domestic livestock in surrounding areas.
Waterfowl: The endangered West Indian Tree-Duck *Dendrocygna arborea* is a resident breeding bird.
Other fauna: No information.
Threats: None known.
Research and conservation: The mangrove swamps are of considerable botanical interest in having no direct communication with the sea; they have been the subject of a detailed study by Stoddart *et al.*
References: Stoddart *et al* (1973); Putney (1982).
Source: See references.
Criteria for inclusion: 2a & 3a.

The Flashes (6)

Location: 17°33'N, 61°45'W; near Cocoa Point at the southeast tip of Barbuda.
Area: 150 ha.
Altitude: Near sea level.
Province and type: 8.41.13; 07 & 08.
Site description: A group of shallow hypersaline lagoons and salt flats subject to periodic flooding during high spring tides or after heavy rain. Parts remain permanently flooded and there is some sparse mangrove woodland.
Principal vegetation: Scattered mangroves *Avicennia germinans* and *Laguncularia racemosa*, *Batis maritima* and species of *Salicornia*; cactus scrub in surrounding areas.
Land tenure: Public land (state owned).
Protection: None.
Land use: Some of the lagoons are used for salt production.
Waterfowl: No information.
Other fauna: There are sea turtle nesting areas on nearby beaches.
Threats: No information.
References: Stoddart *et al* (1973); Putney (1982).
Source: See references.
Criteria for inclusion: 3a.

BAHAMAS

INTRODUCTION

by **The Bahamas National Trust**

The Bahama Islands are an archipelago in the southwestern North Atlantic between latitudes 20°50'N and 27°25'N, and longitudes 70°00'W and 80°32'W. The islands vary greatly in size and are principally distributed on four shallow banks with seas less than 9m deep. These are the Great Bahama, Little Bahama, Cay Sal and Caicos Banks. Most of the eastern and southern islands are detached from the major banks and are surrounded by waters which reach depths of between 2,000 and 4,000m. The various banks total approximately 125,000 sq. km, but only about 14,000 sq. km are above sea level. It is generally considered that the dry land includes 29 inhabited islands, some 660 cays and almost 2,400 rocky islets ("rocks"). The total population of the Commonwealth of The Bahamas was about 225,000 in 1978.

The islands and cays are low-lying, with an average elevation of only 10m. Many of them have low hills which may reach 30-60m in height. The dominant vegetation is low, dense and thorny, the major vegetation types being as follows:

a) Mangrove swamps and marshes. The Black Mangrove *Avicennia germinans*, White Mangrove *Laguncularia racemosa* and Red Mangrove *Rhizophora mangle* are found throughout the islands. Other species associated with mangrove swamps and brackish to saline marshes include *Conocarpus erectus, Typha sp, Dichromena latifolia, Cladium sp, Eleocharis sp, Tillandsia sp, Polypodium polypoides, Najas marina* and *Utricularia purpurea.* In addition, there are some small areas of freshwater marsh with *Acrostichum sp, Cabomba sp, Potamogeton* sp and *Ceratophyllum demersum.*
b) Beach vegetation. Sandy beaches occur widely throughout the archipelago and have a characteristic flora including *Canavalia obtusifolia, Batis maritima, Ipomoea pescaprae, Sesuvium portulacastrum, Cyperus mariscus, Coccoloba uvifera, Suriana maritima, Chrysobalanus icaco, Conocarpus erectus, Coccothrinax argentata* and *Casuarina litorea.*
c) Swashes. These are extensive areas of mudflats bordering mangrove swamps, ponds and lagoons, characteristically with little or no permanent vegetation. Mangroves may attempt to grow but the shoots seldom reach a height of more the 10-15 cm.
d) Pine forests or "barrens". Tracts of pine woodland with numerous palms; the dominant species are *Pinus elliottii, P. caribea, Acoelorrhaphe wrightii, Sabal palmetto, Thrinax morrisii* and *Coccothrinax argentata.*
e) Mixed broad-leaf coppice. Mixed broad-leaf woodland with a wide variety of trees, shrubs and bromeliads including species of *Baccharis, Mimosa, Tamarindus, Acacia, Pithecellobium, Swietenia, Bursera, Ficus, Clusia* and *Tillandsia.*

Almost every major island contains some wetland habitat, and several islands, such as Grand Bahama, Abaco, Andros and Great Inagua, have enormous tracts of wetland. The great majority of this is comprised of shallow brackish to saline lagoons, mangrove swamps, coastal flats and intertidal mudflats. Many areas are difficult of access and remain very poorly known. The present inventory has been based to a large extent on a report compiled for IUCN by G. Carleton Ray on critical marine habitats of the wider Caribbean area.

Institutional Base for Wetland Conservation and Research

The governmental organization responsible for environmental conservation in the Bahamas is the Ministry of Agriculture, Fisheries and Local Government, with its headquarters in Nassau, New Providence. The only non-governmental conservation body is The Bahamas National Trust, also based in Nassau. This was created in 1959 by an Act of Parliament, and now has over 1,000 members. The Trust is concerned with the conservation of wildlife, particularly threatened and endangered species, the protection of critical habitats, and the preservation of places of historic interest and great natural beauty. Programmes include public and school education, protection and study of the flamingos on Great Inagua, and sea turtle research. The Trust publishes a journal of natural history, the "Bahamas Naturalist".

Progress in Wetland Conservation and Research

In 1905, an Act entitled "The Wild Birds (Protection) Act" was established with the cooperation and guidance of the U.S. National Audubon Society. This statute law was revised in 1965 (Chapter 28, Wild Birds Protection Act). Subsidiary legislation of this Act defines Section 4 (Reserves) and lists areas throughout the Bahamas which are recognized as Wild Birds Protection Reserves. The Act was further revised and strengthened in 1972.

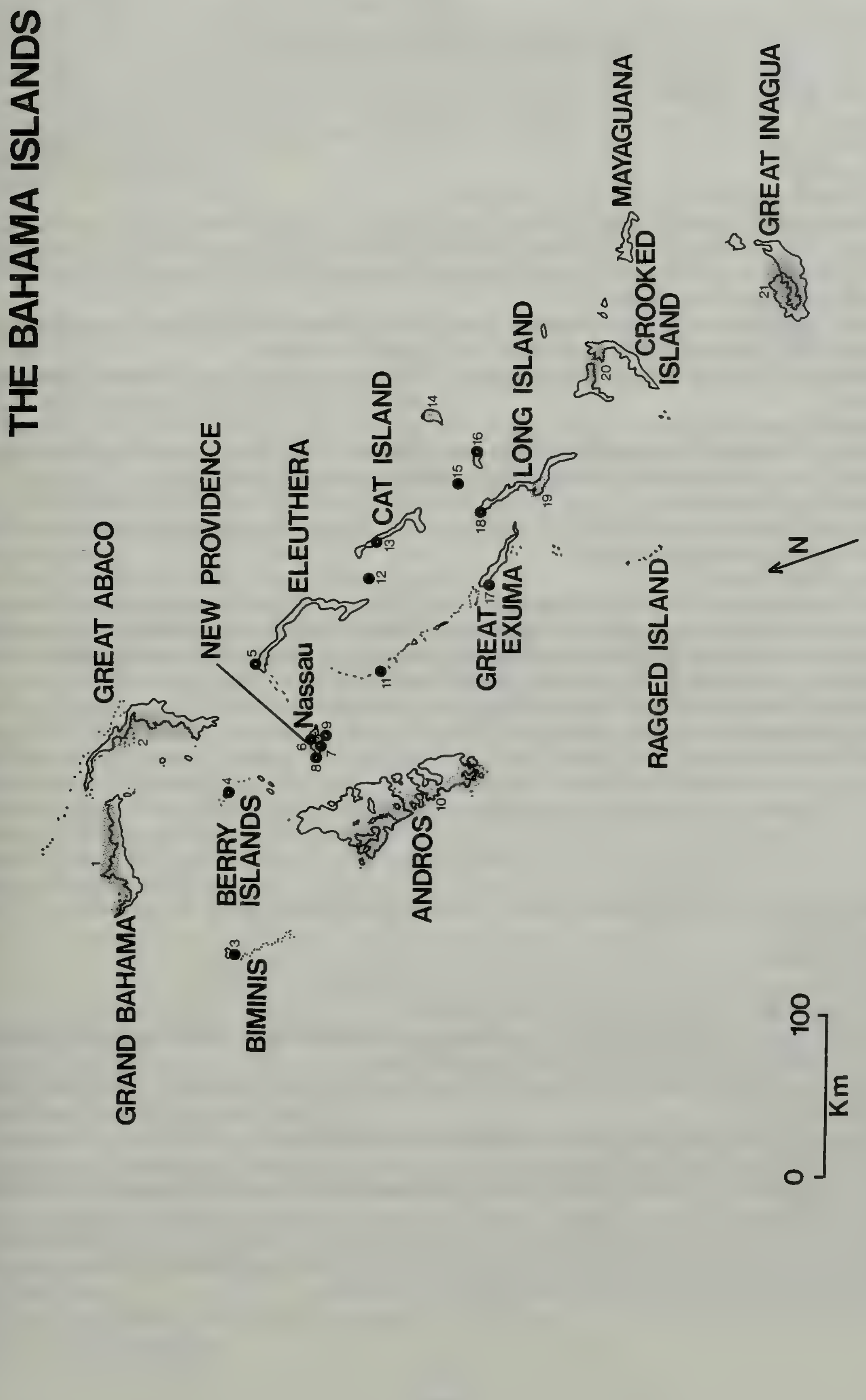
Section 4 of the Wild Birds Protection Act currently lists twenty-five sites as Wild Bird Reserves. In addition to these, The Bahamas National Trust has under its jurisdiction eight national parks; three of these parks (Inagua National Park, Conception Island National Park and Lake Cunningham National Reserve) are specifically protected for their waterfowl populations.

In August 1983, The Bahamas National Trust submitted to the Government a proposal entitled "The Development of a National Park System for the Commonwealth of The Bahamas". This proposal identifies fifty-two sites throughout the islands which the Bahamas National Trust feels should be given some degree of protection, and defines three suitable categories of protection, namely National Parks, National Reserves and Protected Areas. Although the Trust has had no official response from the Government concerning this proposal, it is optimistic that in due time the proposal will be accepted.

Research work conducted to date on the wetlands and/or waterfowl of the Bahamas has been limited almost entirely to general survey work and studies of the flamingos *Phoenicopterus ruber* on Great Inagua. The most recent survey providing some information on waterfowl was that conducted by Alexander Sprunt IV of the U.S. National Audubon Society on the status and conservation of sea-birds in the Bahamas (Sprunt, 1984). This survey, carried out jointly with officials of The Bahamas National Trust, has involved visits to many of the outer islands, and continues with annual expeditions, usually during May, to update the information.

Major Threats to Wetlands and Waterfowl

Some wetland habitat has undoubtedly been lost to development for tourism and other purposes, particularly in the northern part of the archipelago, but it does not as yet appear to be a prominent factor in the decline of waterfowl populations. Very little is known about the effects of pollution in Bahamian waters. No major oil spills have occurred, but major shipping lanes, some heavily used by tankers, pass through the area. Hunting pressure on waterfowl is very light, and egg-collecting is prohibited under the Wild Birds Protection Act, but the extensiveness and remoteness of many parts of the Bahamas make enforcement of the laws and regulations impossible. Some egg-collection does take place, but only on a subsistence level. There have been no reports of incidental bird mortality from commercial fishing in Bahamian waters, but this must occur, and the situation should be monitored.


THE BAHAMA ISLANDS
GRAND BAHAMA
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BIMINIS
BERRY ISLANDS
NEW PROVIDENCE
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WETLANDS

Site descriptions based on data sheets provided by Alexander Sprunt IV, Susan Holowesko and colleagues at The Bahamas National Trust.

Grand Bahama Northern Coast (1)

Location: 26°40'N, 78°30'W; the entire north coast of Grand Bahama from West Point to East End Point.
Area: 49,800 ha.
Altitude: 0m.
Province and type: 8.38.13; 01, 03, 06, 07 & 08.
Site description: Extensive coastal flats and intertidal mudflats with very little vegetation (swashes), and numerous small offshore islands (cays) with mangrove swamps, stretching for 165 km along the north coast of Grand Bahama. Geological features known as blue holes are scattered throughout the region.
Principal vegetation: Mangrove swamps; broad-leaf coppice with scattered, and in some cases extensive, pine woodland (pine barrens) on the adjacent mainland.
Land tenure: 60% state owned (Crown Land), 40% owned by the Grand Bahama Development Co. Ltd.
Protection: None.
Land use: The region is undeveloped and the mangrove areas are at present undisturbed, but there has been a considerable amount of exploitation of the pine forests.
Waterfowl: No information.
Other fauna: Several rare species of Crustaceans, and in some cases forms new to science, have been discovered in the blue holes.
Threats: None known.
Research and conservation: The Bahamas National Trust has identified the southeast portion of the wetland (encompassing Big Harbour Cay, Sweetings Cay and Lightbourn's Cay) as one of 52 priority sites in its National Parks System Proposal of 1983. The area contains the last remaining stand of virgin pine forest on Grand Bahama.
References: Bahamas National Trust (1983).
Source: The Bahamas National Trust.
Criteria for inclusion: 0.

The Marls (2)

Location: 26°25'N, 77°10'W; from Cooper's Town to Sandy Point, along the west coast of Great Abaco Island.
Area: 38,400 ha.
Altitude: 0m.
Province and type: 8.38.13; 01, 03, 05, 06, 07 & 08.
Site description: Extensive mangrove swamps and coastal flats, with numerous mangrove covered islands, intertidal mudflats and sandy beaches.
Principal vegetation: Mangrove swamps; sandy scrub, pine forest and mixed broad-leaf coppice on higher ground.
Land tenure: 98% state owned (Crown Land), 2% privately owned.
Protection: None.
Land use: Commercial and sport fishing; hunting, mainly for *Columba leucocephala*, during the open season.
Waterfowl: Little information available. *Anas bahamensis* is known to breed; *Phoenicopterus ruber* is a regular feeding visitor and may breed; and recent reports suggest that there may be a small breeding colony of *Pelecanus occidentalis* in the area.

Other fauna: An important nursery ground for juveniles of many marine animals including the Spiny Lobster *Panulirus argus* and several commercially important fishes. The rare and endangered Bahama Parrot *Amazona leucocephala bahamensis* occurs in the pine forests adjoining the southern end of the wetland.
Threats: There is no forseeable threat to the wetlands at present, but the area is difficult to monitor and there is a fair amount of illegal hunting.
Research and conservation: The Bahamas National Trust has identified The Marls as one of 52 priority areas for protection in its National Parks System Proposal of 1983, and has recommended the establishment of a National Reserve. No official response has as yet been received.
References: The Bahamas National Trust (1983); Sprunt (1984).
Source: The Bahamas National Trust.
Criteria for inclusion: 2c.

North Bimini (3)

Location: 25°45'N, 79°15'W; 5 km NNE of Alice Town, Bimini Islands.
Area: 800 ha.
Altitude: 0m.
Province and type: 8.38.13; 01, 03, 05, 06, 07 & 08.
Site description: A shallow sea bay and lagoon with extensive fringing mangroves, tidal mudflats and several low sandy islets; bordered by island masses on three sides. Water levels are influenced by rainfall and to a lesser extent the tides.
Principal vegetation: Mangrove swamps; sandy scrub on the islets.
Land tenure: State owned (Crown Land).
Protection: None.
Land use: Commercial fishing and tourist recreation.
Waterfowl: No information.
Other fauna: The eastern part of the area is reportedly an important nursery ground for juvenile Spiny Lobsters *Panulirus argus*. The critically endangered Bimini Boa *Epicrates striatus fosteri* is confined to three of the Bimini Islands including North Bimini; it is found in mangroves, coppice and scrub, and presumably occurs at this site.
Threats: The Biminis are exposed to heavy tourist traffic. Many Florida-based fishing and diving operations offer one-day package trips to the Islands, and much of the marine environment is suffering from over-use. The Bimini Boa is seriously threatened as a result of collecting by amateur herpetologists, habitat destruction and general human persecution.
References: WWF Red Data Book.
Source: The Bahamas National Trust.
Criteria for inclusion: 2a & 2c.

Great Harbour Cay (4)

Location: 25°43'N, 77°51'W; in the northern Berry Islands.
Area: 1,000 ha.
Altitude: 0m.
Province and type: 8.38.13; 03, 06 & 07.
Site description: A shallow coastal lagoon with extensive coastal flats and intertidal mudflats with very little vegetation (swashes), and many small islands; bordered on three sides by island masses and open to shallow sea at the southern end. There is some tidal influence in the lagoon.
Principal vegetation: Sandy scrub and scattered areas of mixed broad-leaf coppice on the adjacent islands.
Land tenure: State owned (Crown Land).
Protection: None.
Land use: Local fishing, with a heavy emphasis on lobster.
Waterfowl: No information.

Other fauna: An important nursery ground for juvenile Spiny Lobster *Panulirus argus*
Threats: As the Berry Islands are developed, there is the possibility that the wetlands could be threatened by expansion of the airstrip on Great Harbour Cay.
Source: The Bahamas National Trust.
Criteria for inclusion: 0.

The Bluff Wetlands (5)

Location: 25°30'N, 76°40'W; at the northwest tip of Eleuthera Island.
Area: 1,600 ha.
Altitude: 0m.
Province and type: 8.38.13; 01, 05, 06, 07 & 08.
Site description: Extensive coastal flats and intertidal mudflats with very little vegetation (swashes), sandy beaches, and a few stands of mangroves; around shallow sea bays south and northeast of The Bluff.
Principal vegetation: Some mangrove; mixed broad-leaf coppice inland.
Land tenure: Partly public land (commonage) and partly privately owned.
Protection: None.
Land use: A popular area for sport fishing and commercial fishing, with some minor development.
Waterfowl: No information.
Other fauna: The Bluff wetlands and the adjacent Corrie Sound are an important nursery ground for juveniles of many marine animals, particularly Spiny Lobsters *Panulirus argus*.
Threats: Over-fishing may be a problem.
Source: The Bahamas National Trust.
Criteria for inclusion: 2c.

Lake Cunningham (6)

Location: 25°04'N, 77°25'W; 7 km west of Nassau, New Providence.
Area: 70 ha.
Altitude: 0m.
Province and type: 8.38.13; 07 & 08.
Site description: A permanent shallow brackish lake, up to 1.5m deep, with some fringing mangrove swamps, mangrove covered islands, and low-lying swampy areas. The water level is dependent on rainfall, and there is some drying out at the east end during dry periods.
Principal vegetation: Mangrove swamps with *Conocarpus erectus* and *Rhizophora mangle*, and some brackish marshes.
Land tenure: State owned (Crown Land), with private properties bordering the lake's shoreline.
Protection: A Wildbird Reserve, as defined in the Wildbirds Protection Act.
Land use: Until 1983, little disturbed, but now used for powerboat racing.
Waterfowl: Few birds breed, but a wide variety of species has been recorded on passage and in winter, notably *Phalacrocorax* sp (almost certainly *P. auritus*), many Ardeidae, *Anas discors*, *Aythya collaris*, *A. affinis*, *Fulica americana* and many shorebirds. *Oxyura jamaicensis* has occurred in small numbers in recent years.
Other fauna: No information.
Threats: The Ministry of Tourism recently granted permission to a local (and international) powerboat racing organization to use the lake as a site for international racing events. Vegetation between the lake and a nearby road has been cleared and parts of the eastern marshes have been filled.
Research and conservation: The Bahamas National Trust is attempting to have the frequency of boat races brought down to a minimum, and to have the vegetation around the lake restored.
Source: The Bahamas National Trust.
Criteria for inclusion: 3a.

Lake Killarney (7)

Location: 25°03'N, 77°26'W; 10 km WSW of Nassau, New Providence.
Area: 1,050 ha.
Altitude: 0m.
Province and type: 8.38.13; 07.
Site description: A permanent shallow brackish lake, up to 1.5m deep, with surrounding low-lying swampy areas. The water level fluctuates with local rainfall.
Principal vegetation: Brackish swamps.
Land tenure: State owned (Crown Land).
Protection: None.
Land use: Occasional bird hunting.
Waterfowl: No information.
Other fauna: No information.
Threats: The lake is threatened by possible extension of Nassau's international airport which would involve the filling in of the southwest portion of the lake.
Research and conservation: The Bahamas National Trust has identified Lake Killarney as one of 52 priority sites for protection in its National Parks System Proposal of 1983, and has recommended the establishment of a National Reserve.
References: The Bahamas National Trust (1983).
Source: The Bahamas National Trust.
Criteria for inclusion: 3a.

Lightbourn Creek (8)

Location: 25°03'N, 77°32'W; 17 km WSW of Nassau, New Providence.
Area: 200 ha.
Altitude: 0m.
Province and type: 8.38.13; 06, 07 & 08.
Site description: A shallow tidal creek, 1m deep at low tide, bordered by dense mangrove swamps and tidal mudflats.
Principal vegetation: Mangrove swamps.
Land tenure: Owned by the New Providence Land Development Company.
Protection: Lightbourn Creek has been declared a Wildbird Reserve under the Wildbirds Protection Act.
Land use: Although designated a Wildbird Reserve, permission has been granted for dredging, filling and development. Some dredging and filling have taken place.
Waterfowl: No information.
Other fauna: An important nursery ground for juvenile fishes and Spiny Lobsters *Panulirus argus*.
Threats: The Creek is currently the focus of a legal battle between residents of the area and a development company which has plans to fill the creek and construct condominiums on the adjacent point. The protection status of the creek is being challenged at this time.
Research and conservation: One of the last virgin stands of mangrove swamp in the New Providence and Paradise Island area. It was an oversight that the area was not included in the initial National Parks System Proposal of The Bahamas National Trust, and it will undoubtedly be included at some later date.
Source: The Bahamas National Trust.
Criteria for inclusion: 3a.

Millers Sound and Bonefish Pond (9)

Location: 25°00'N, 77°25'W; 10 km southwest of Nassau, New Providence.
Area: 600 ha.
Altitude: 0m.
Province and type: 8.38.13; 06, 07 & 08.

Site description: A complex of tidal marshes with some mangroves, and adjacent permanent and semi-permanent brackish ponds fed by rainfall.
Principal vegetation: Brackish marshes and a few isolated stands of mangroves.
Land tenure: State owned (Crown Land).
Protection: None.
Land use: Some sport hunting for birds, and fishing.
Waterfowl: No information.
Other fauna: No information.
Threats: As New Providence continues to be developed at a rapid pace, there is an ever present threat of filling in and drainage for development.
Research and conservation: The Bahamas National Trust has identified this wetland as one of 52 priority sites for protection in its National Parks System Proposal of 1983, and has recommended the establishment of a National Reserve. It is hoped that the Government will move quickly on this proposal and give Millars Sound and Bonefish Pond adequate legal protection before it is too late. The area has been identified as the most ideal location for the re-introduction of *Phoenicopterus ruber* on New Providence.
References: The Bahamas National Trust (1983).
Source: The Bahamas National Trust.
Criteria for inclusion: 3a.

Western Andros (10)

Location: 24°30'N, 78°00'W; the western side of Andros Island from near Owens Town to the southern tip of the island.
Area: 270,000 ha.
Altitude: 0m.
Province and type: 8.38.13; 01, 03, 05, 06, 07 & 08.
Site description: A vast complex of low-lying islands and tidal channels, up to 2m deep, with extensive coastal flats and intertidal mudflats with very little vegetation (swashes), sandy beaches, numerous shallow brackish lagoons and ponds, and some mangrove swamps. Water levels are dependent both on the tides and on local rainfall. Blue holes (inland pools connected with the sea through subterranean cave systems) occur throughout the area.
Principal vegetation: A few stands of mangroves; areas of open scrub with seasonal marsh, mixed broad-leaf coppice and pine forest scattered throughout on higher ground.
Land tenure: 98% state owned (Crown Land), 2% privately owned.
Protection: None.
Land use: There is very little human activity in the area.
Waterfowl: Little information is available, but the area is known to be very important for a wide variety of breeding, passage and wintering waterfowl. Breeding species include *Ixobrychus exilis*, *Egretta rufescens*, *Anas bahamensis* and *Haematopus palliatus*; *Phoenicopterus ruber* is a regular feeding visitor and may breed. The rare West Indian Tree-Duck *Dendrocygna arborea* still occurs in the area and probably breeds. *Eudocimus albus* and *Plegadis falcinellus* have been recorded on passage, and *Ardea herodias* and *Anas discors* are common in winter.
Other fauna: Southern Andros is a very important breeding area for the White-crowned Pigeon *Columba leucocephala*, the most popular game-bird in the Bahamas. An endemic subspecies of the rare Bahamian Rock Iguana occurs on the island.
Threats: Unknown, but probably none.
Research and conservation: The blue holes are currently being studied by the British Cave Diving Expeditions. The Bahamas National Trust included the northwestern corner of this huge wetland in its National Parks System Proposal of 1983, and recommended the establishment of a National Reserve.
References: The Bahamas National Trust (1983).
Source: The Bahamas National Trust.
Criteria for inclusion: 123.

Shroud Cay (11)

Location: 24°30'N, 76°45'W; near the northwest end of the Exuma Cays.
Area: 800 ha.
Altitude: 0m.
Province and type: 8.38.13; 01, 03, 05, 06, 07 & 08.
Site description: Extensive brackish marshes, coastal flats and intertidal mudflats with very little vegetation (swashes), and some small isolated stands of mangroves; with an eastern fringe of higher ground and a chain of small sandy islands and cays along its western fringe. Parts of the interior of the marsh dry out between June and September.
Principal vegetation: Brackish marshes and some mangrove swamps; broad-leaf coppice and sandy scrub on higher ground.
Land tenure: State owned (Crown Land).
Protection: Protected within the Exuma Cays Land and Sea Park (45,584 ha), established in 1958 and under the jurisdiction of the Bahamas National Trust.
Land use: Controlled sport fishing.
Waterfowl: No information.
Other fauna: A critical nursey ground for juvenile Queen Conch *Strombus gigas*, the most important source of protein for Bahamians.
Threats: None known.
Research and conservation: The area was surveyed by the Exuma Cays Expedition in 1958.
References: IUCN (1982).
Source: The Bahamas National Trust.
Criteria for inclusion: 2c.

Little San Salvador Interior (12)

Location: 24°34'N, 75°56'W; 20 km west of the north end of Cat Island.
Area: 270 ha.
Altitude: 0m.
Province and type: 8.38.13; 07.
Site description: A permanent brackish lagoon with open connection to the sea, several small islands, and some permanent brackish marshes along the southern shore. The lagoon occupies much of the interior of Little San Salvador Island.
Principal vegetation: Brackish marshes; sandy scrub on the islands and south shore, mixed broad-leaf coppice on the north shore.
Land tenure: Privately owned.
Protection: None.
Land use: None.
Waterfowl: No information.
Other fauna: No information.
Threats: Unknown, but probably none.
Source: The Bahamas National Trust.
Criteria for inclusion: 0.

Bennett's Harbour Creek (13)

Location: 24°32'N, 75°36'W; 10 km SSE of Arthur's Town, Cat Island.
Area: 1,950 ha.
Altitude: 0m.
Province and type: 8.38.13; 07, 08 & 13.
Site description: A shallow tidal creek opening to the sea at Alligator Point, and bordered by low-lying brackish swamps with some small freshwater ponds, and isolated stands of mangroves.
Principal vegetation: Brackish marshes and mangrove swamps; patches of scrub and small areas of mixed broad-leaf coppice on higher ground.
Land tenure: 10% state owned (Crown Land), 90% privately owned.

Protection: None.
Land use: No information.
Waterfowl: No information.
Other fauna: The endangered Cat Island Turtle *Pseudemys felis*, endemic to the island and confined to shallow freshwater ponds near the west coast, occurs in ponds bordering Bennett's Harbour Creek and around the settlement of Bluff to the south.
Threats: The main wetlands are probably under no threat. The Cat Island Turtle is threatened by land development around some of the ponds, and capture for food and for pets.
Research and conservation: Studies are being conducted on the Cat Island Turtle by The Bahamas National Trust, the Ocean Research and Education Society, Inc., and the Animal Research and Conservation Center of the New York Zoological Society.
References: WWF Red Data Book.
Source: The Bahamas National Trust.
Criteria for inclusion: 2a & 3a.

San Salvador Interior (14)

Location: 24°03'N, 74°28'W; the interior of San Salvador Island.
Area: 5,625 ha.
Altitude: 0m.
Province and type: 8.38.13; 06, 07 & 08.
Site description: A complex of permanent shallow saline lagoons and ponds with extensive brackish to saline marshes, and a coastal lagoon (Pigeon Creek) with open connection to the sea. Pigeon Creek is tidal; the water level in the other lagoons and marshes is influenced by rainfall.
1&k10HPrincipal vegetation: Brackish and saline marshes, and a few isolated stands of man
mixed broad-leaf coppice on higher ground.
Land tenure: State owned (Crown Land).
Protection: None.
Land use: There is very little human activity in the area.
Waterfowl: Little information is available, but the area is known to be important for breeding, passage and wintering waterfowl of a wide variety of species. Breeding birds include *Podilymbus podiceps*, *Phalacrocorax olivaceus*, several Ardeidae, *Charadrius vociferus* and *Sterna albifrons*. The rare West Indian Tree-Duck *Dendrocygna arborea* may still occur on the island.
Other fauna: Several pairs of *Pandion haliaetus* breed.
Threats: Probably none.
Research and conservation: It has been many years since a proper survey of this island was conducted. Miller carried out some avifaunal studies in the mid 1970s, and a major survey is planned for 1985.
References: Miller (1978).
Source: The Bahamas National Trust.
Criteria for inclusion: 3a.

Conception Island Interior (15)

Location: 23°50'N, 75°07'W; the interior of Conception Island, between Cat Island and Rum Cay.
Area: 675 ha.
Altitude: 0m.
Province and type: 8.38.13; 03, 06, 07 & 08.
Site description: A permanent shallow saline lagoon with several islands and a narrow connection with the open sea. The lagoon occupies much of the interior of Conception Island and is surrounded by mudflats, mangrove swamps and brackish to saline marshes. It is less than 1m deep at high water, and parts of the marshes dry out at low water.

Principal vegetation: Brackish to saline marshes and mangrove swamps; mixed broad-leaf coppice and patches of sandy scrub on higher ground.
Land tenure: State owned (Crown Land); leased to The Bahamas National Trust on a 99 year lease.
Protection: The Island is protected in a Land and Sea Park of 810 ha under the jurisdiction of The Bahamas National Trust. It is unlawful to remove any plant or animal life, with the exception of the daily bag limit of certain edible marine species.
Land use: The island is uninhabited, and is visited only by cruising yachts and Haitian refugees.
Waterfowl: Little information available, but known to be an important stop-over for migratory birds.
Other fauna: There are colonies of sea-birds on the nearby Booby Cay and South Rocks, and Green Sea Turtles *Chelonia mydas* nest on the beaches.
Threats: There are no existing or forseeable threats to the wetland habitat. Haitian refugees have, in the past, contributed to a litter problem on the beaches, and it is probable that the waterfowl are occasionally exploited by the refugees.
Research and conservation: On-going research by The Bahamas National Trust and the U.S. National Audubon Society consists of surveys (annual when possible) of sea-bird populations and the general condition of the environment.
References: IUCN (1982).
Source: The Bahamas National Trust.
Criteria for inclusion: 3a.

Wetlands on Rum Cay (16)

Location: 23°40'N, 74°48'W; on Rum Cay, northeast of Long Island.
Area: 416 ha.
Altitude: 0m.
Province and type: 8.38.13; 07.
Site description: Five permanent land-locked brackish lagoons with some seasonal marshes, including Lake George (300 ha), Bay Pond (20 ha), Long Pond (20 ha), Lime Pond (20 ha), and one other pond (56 ha). The water levels fluctuate according to local rainfall.
Principal vegetation: Open scrub with seasonal marshes; mixed broad-leaf coppice on higher ground.
Land tenure: Almost exclusively state owned (Crown Land).
Protection: None.
Land use: There is little human activity in the area.
Waterfowl: No information.
Other fauna: No information.
Threats: No information.
Source: The Bahamas National Trust.
Criteria for inclusion: 0.

Stuart Manor Wetlands (17)

Location: 23°37'N, 76°00'W; near the west end of Great Exuma, 30 km northwest of Georgetown.
Area: 1,350 ha.
Altitude: 0m.
Province and type: 8.38.13; 01, 03, 06, 07 & 08.
Site description: A shallow sea bay with extensive coastal flats and intertidal mudflats with very little vegetation (swashes), some mangrove swamps, and several small islands.
Principal vegetation: Brackish marshes and some mangrove swamps; mixed broad-leaf coppice and some open scrub on higher ground.
Land tenure: State owned (Crown Land).
Protection: None.
Land use: There is little human activity in the area.

Waterfowl: No information.
Other fauna: No information.
Threats: Unknown, but probably none.
Source: The Bahamas National Trust.
Criteria for inclusion: 0.

Joe's Sound and Glenton Sound (18)

Location: 23°38'N, 75°20'W; at the northern tip of Long Island.
Area: 1,500 ha.
Altitude: 0m.
Province and type: 8.38.13; 01, 03, 05, 06, 07 & 08.
Site description: A complex of coastal flats and intertidal mudflats with very little vegetation (swashes), scattered stands of mangroves, sandy beaches and tidal channels between Galliot Cay and the north end of Long Island.
Principal vegetation: Brackish marshes and some mangroves; sandy scrub on Galliot Cay and predominantly mixed broad-leaf coppice on the Long Island coast.
Land tenure: Mainly state owned (Crown Land), with some private holdings.
Protection: None.
Land use: There is an airstrip on Galliot Cay and a large settlement (Stella Maris) nearby.
Waterfowl: No information.
Other fauna: No information.
Threats: There is a possible future threat to the wetlands from the expansion of tourist facilities in the area. Control of fish-eating birds at shrimp and fish farms near Deadman's Cay to the south may be affecting waterfowl populations.
Source: The Bahamas National Trust.
Criteria for inclusion: 0.

New Found Harbour and Grand Pa's Channel (19)

Location: 23°08'N, 75°08'W; on the west coast of Long Island, near Deadman's Cay.
Area: 5,700 ha.
Altitude: 0m.
Province and type: 8.38.13; 01, 03, 05, 06, 07 & 08.
Site description: A complex of coastal flats and intertidal mudflats with very little vegetation (swashes) in a shallow sea bay, with several sandy islands and scattered patches of mangroves.
Principal vegetation: Saline marshes and some mangrove swamps; mixed broad-leaf coppice and some areas of open scrub on the islands and coast of Long Island.
Land tenure: Mainly state owned (Crown Land).
Protection: None.
Land use: Shrimp farming and fish farming, both on the increase.
Waterfowl: No information.
Other fauna: No information.
Threats: A new shrimp and fish farming operation has recently been set up in the Deadman's Cay area. Some problems have arisen with fish-eating birds feeding in the ponds, and control measures may be affecting waterfowl populations island-wide.
Source: The Bahamas National Trust.
Criteria for inclusion: 0.

The Bight of Acklins (20)

Location: 22°40'N, 74°05'W; the south coast of Crooked Island and northwest coast of Acklins Island.
Area: 14,200 ha.
Altitude: 0m.
Province and type: 8.38.13; 01, 03, 05, 06, 07 & 08.
Site description: A complex of coastal flats and intertidal mudflats with very little vegetation (swashes), offshore cays and scattered stands of mangroves around a large shallow sea bay (The Bight of Acklins).
Principal vegetation: Saline marshes and mangrove swamps; mixed broad-leaf coppice on the cays and mainland coast.
Land tenure: State owned (Crown Land).
Protection: None.
Land use: Possibly some subsistence fishing, but generally very little disturbed.
Waterfowl: No information.
Other fauna: No information.
Threats: Unknown, but probably none.
Source: The Bahamas National Trust.
Criteria for inclusion: 0.

Inagua National Park and Lake Rosa (21)

Location: 21°05'N, 73°30'W; Great Inagua Island.
Area: 32,600 ha.
Altitude: 0m.
Province and type: 8.38.13; 01, 03, 05, 06, 07 & 08.
Site description: Lake Rosa is a permanent shallow brackish lake, up to 1.5m deep, with small islands scattered throughout, and a fringe of brackish marshes; there are dense mangrove swamps on the northern and eastern borders, and the lake is surrounded by a broad belt of open scrub with seasonal marshes. Other wetlands in the National Park include: (a) Union Creek, a saline lagoon with opening to the sea, extensive salt marshes and scattered mangroves; (b) a permanent brackish marsh with many scattered pools and some mangroves, south of Palacca Point; and (c) Close in Point Lakes, a permanent brackish marsh with dense mangrove swamps, northwest of South East Point.
Principal vegetation: Brackish to saline marshes, mangrove swamps with *Avicennia germinans* and *Conocarpus erectus*, and open scrub with seasonal marshes; some broad-leaf coppice on higher ground.
Land tenure: State owned (Crown Land); under the jurisdiction of The Bahamas National Trust on a 99 year lease (until 2062).
Protection: Most of the island's wetlands are completely protected within the Inagua National Park (74,333 ha) established in 1965, but the west end of Lake Rosa is apparently unprotected. The National Park is patrolled by three National Trust wardens.
Land use: None.
Waterfowl: A very important area for breeding, passage and wintering waterfowl of a wide variety of species, and particularly important for its large breeding colony of the Caribbean Flamingo *Phoenicopterus ruber ruber*. The Inagua population was estimated at about 21,000 birds (6,000 breeding pairs) in the early 1970s, but under close protection, the population has risen to an estimated 40,000-50,000 birds in recent years. Other breeding species include *Pelecanus occidentalis* (100-200 pairs), *Phalacrocorax olivaceus, Nyctanassa violacea, Butorides virescens, Egretta caerulea, E. tricolor, E. rufescens* (200 pairs), *E. alba, Ajaia ajaja* (50 pairs), *Dendrocygna arborea* (tens of birds), *Anas bahamensis, Charadrius vociferus, C. alexandrinus, Himantopus himantopus, Gelochelidon nilotica* and *Sterna albifrons* (several colonies including one of 300 pairs). *Eudocimus albus* and *Plegadis falcinellus* occur on passage, and *Ardea herodias* is common in winter.
Other fauna: The endangered Inagua Island Turtle *Chrysemys malonei*, endemic to Great Inagua, is restricted to a few fresh or brackish pools on the island. The rare Bahama Parrot *Amazona leucocephala bahamensis* occurs only on this island and on Abaco.

Threats: There is no forseeable threat to the wetland habitat other than the ever present natural threat of hurricane damage. Waterfowl populations are threatened to a very limited extent by introduced Wild Boars *Sus scrofa*.
Research and conservation: A number of avifaunal surveys have been conducted in the National Park, and there is a Green Sea Turtle *Chelonia mydas* captive breeding project at Union Creek.
References: Allen (1956); Sprunt (1975 & 1984); IUCN (1982); WWF Red Data Book.
Source: The Bahamas National Trust.
Criteria for inclusion: 123.

BARBADOS

INTRODUCTION

based on information provided by Maurice B. Hutt

Barbados, the most easterly of the Caribbean islands, lies about 150 km east of the Lesser Antillean island arc and 300 km NNE of Trinidad. With an area of only 430 km^2 and a population of about 300,000, Barbados is one of the most densely populated islands in the world. A British Colony from 1627, the island achieved independence within the Commonwealth in 1966.

The climate is tropical, but because of the cooling influence of the NE Trade winds, temperatures rarely exceed 32°C. The average annual rainfall varies from about 1,150 mm on the coast to 1,900 mm in the hills; most falls during the rainy season from June to November. The topography is rolling, with hills rising to 338m, and much of the land is under cultivation, particularly for sugar cane. Tourism is extremely important in the island's economy, and there are extensive tourist developments on the south and west coasts. Native vegetation is now more or less confined to a few small patches in the hills and along the exposed east coast which has remained relatively undeveloped.

There are extensive offshore coral reefs and sea-grass beds, but very few natural wetlands on the island. These include several small permanent and seasonal brackish to saline coastal lagoons and three patches of mangroves. However, each year the island's wealthier hunters create shallow impoundments of up to 2 ha in extent on agricultural land, to attract migratory shorebirds which pass over the island in large numbers during the autumn migration season (mid July to mid October). In the early 1960s, as many as twenty such ponds, or "trays" as they are known, were created each year. Since then the number has decreased to about eight or ten.

Very few species of waterfowl breed on the island and only *Bubulcus ibis* is common. However, the endangered nominate race of the Yellow Warbler *Dendroica petechia petechia* is endemic to the island, and almost confined to the mangrove swamps. Many species of waterfowl occur on passage and in winter, particularly Ardeidae and shorebirds, but numbers are generally small except during adverse weather conditions in autumn, when large numbers of shorebirds may be grounded.

Institutional Base for Wetland Conservation and Research

The governmental statutory body responsible for the natural environment is the National Conservation Commission, formerly the Parks and Beaches Commission established in 1970. This is primarily concerned with administering the one national park and a number of public recreation areas and beaches.

There are several non-governmental bodies in Barbados with interests in conservation.

Caribbean Conservation Association (CCA). This international organization with fifteen member states in the wider Caribbean has its headquarters in St. Michael, Barbados. It was created in 1967 to ascertain the conservation needs of the Caribbean area and to coordinate conservation activities throughout the region. The CCA has programmes related to environmental education, environmental legislation, museums and historic sites, and natural area management, and publishes a bulletin "Caribbean Conservation News" in English, Spanish and French.

Barbados National Trust. This was created in 1961 and incorporated by Statute in 1962; its objectives are the preservation and conservation of the country's cultural and natural heritage, and it has been particularly active in preserving sites of historical interest. The Trust was instrumental in revising the Schedule to the Wild Birds' Protection Act in 1979.

Barbados Wildlife Protection Association. This was launched in August 1983 to campaign for the protection of wildlife, especially migratory shorebirds, and for the preservation of wildlife habitats of all description.

University of the West Indies. The Department of History at UWI in Barbados provides assistance in raising the level of public consciousness of environmental issues, and is embarking on a programme of environmental studies.

Progress in Wetland Conservation

The Marine Areas (Preservation and Enhancement) Act of 1976 provides the legal basis for the establishment of coastal and marine parks and reserves. One small marine reserve was created in 1980 on the west coast of the island, and there is a proposal dating from 1979 to create a national park of about 5,000 ha on the east coast. This would include a strip of land up to 2 km wide stretching for 34 km along the coast from Archer's Bay to Ragged Point and incorporating Long Pond, one of the three most important wetlands on the island. One of the other two important wetlands, Graeme Hall Swamp, is partly protected as a no-hunting area, while the other, Chancery Lane Swamp, has been proposed for the establishment of a wildlife sanctuary.

The Wild Birds' Protection Act first became law in 1907, and at that time gave protection to only eleven species, mainly resident birds believed to be beneficial to agriculture. A revised Schedule to the Act giving protection to 46 species including all Ardeidae and four uncommon shorebirds was passed in 1979. Subsequent proposals for revisions giving complete protection to migratory shorebirds have met with considerable opposition.

Major Threats to Wetlands and Waterfowl

The major threats to wetlands in Barbados are urban expansion and development for tourism. The Government is proposing to construct a sewage disposal plant at Graeme Hall Swamp, and there are housing developments planned or in progress at this swamp and Chancery Lane Swamp. There is also some pollution at Graeme Hall Swamp.

Heavy hunting pressure, particularly during the autumn migration season, causes a considerable amount of disturbance to waterfowl populations, and takes a significant toll of the shorebirds visiting the island. In the early 1960s, when some twenty ponds were managed specifically for hunting, as many as 40,000 shorebirds were shot in a single season. Although the number of ponds has decreased in recent years, the use of diesel pumps to maintain optimum water levels and the use of decoys, whistles and amplified tape-recordings to attract birds continue to ensure large bags, and up to 4,000 birds can still be shot at a single pond in a good year. The predominant species in the hunters' bags are *Tringa flavipes (50%), Calidris melanotos (25%) and Pluvialis dominica* (10%). Other species commonly shot include *Pluvialis squatarola, Limosa haemastica, Numenius phaeopus, Tringa melanoleuca, Catoptrophorus semipalmatus, Arenaria interpres, Limnodromus griseus, Calidris alba* and *Micropalama himantopus.*

WETLANDS

Site descriptions based on data sheets provided by Maurice B. Hutt. (For map, see Anguilla.)

Graeme Hall Swamp (1)

Location: 13°04'N, 59°34'W; 5 km east of Bridgetown, Christchurch Parish.
Area: 31.6 ha.
Altitude: 0-2m.
Province and type: 8.41.13; 07 & 08.
Site description: A large brackish pool, up to 4m deep, a small brackish pond, and a brackish sedge marsh and mangrove swamp dissected by parallel drainage channels; separated from the sea by a main road and narrow strip of built-up land. The water level varies by up to 40 cm according to rainfall.
Principal vegetation: One quarter of the area is a mangrove swamp with *Laguncularia racemosa* and *Rhizophora mangle*; most of the remainder is a sedge marsh, with some clumps of *Pluchea carolinensis* and *Leucena leucocephala.*
Land tenure: 20 ha are state owned; the remainder is privately owned and up for sale.
Protection: No habitat protection. All hunting has been prohibited on the area owned by the state since 1980, and no shooting is allowed on the privately owned land.
Land use: A considerable amount of fishing, cattle grazing in the sedge marsh, some grass-cutting for cattle feed, and recreation (model boat racing) on the main pond.
Waterfowl: The main breeding area for *Bubulcus ibis* in Barbados, with a colony of over 5,000 birds, and the main breeding site for *Gallinula chloropus* (10-15 pairs). *Butorides virescens* also breeds. An important area for a wide variety of passage and wintering waterfowl. Wintering birds include *Nycticorax nycticorax, Nyctanassa violacea, Egretta caerulea, E. tricolor, E. thula, E. alba, Ardea herodias, Porzana carolina* and *Tringa solitaria.* Common passage migrants include *Anas discors, Charadrius semipalmatus, Tringa melanoleuca, T. flavipes, Calidris pusilla* and *C. minutilla.* Many other Nearctic shorebirds occur regularly in small numbers, and a wide variety of species have been recorded as vagrants.
Other fauna: The swamp is the stronghold of the nominate race of the Yellow Warbler *Dendroica petechia petechia*, an endangered subspecies confined to Barbados.
Threats: There is an increasing amount of pollution from the adjacent coast road. The Government is proposing to construct a sewage disposal plant on its land, and the privately owned lands are up for sale to developers wishing to construct condominiums.
Research and conservation: The only permanent wetland of its type in Barbados, and particularly interesting floristically. As a relatively unspoiled wetland ecosystem in a heavily populated island, the swamp has great potential for educational purposes, and clearly merits protection. Hutt has recently made a detailed proposal for the establishment and management of a wildlife refuge and ecological reserve.
References: Putney (1982); Hutt (1983).
Source: Maurice B. Hutt.
Criteria for inclusion: 2a, 2b & 3a.

Chancery Lane Swamp (2)

Location: 13°04'N, 59°30'W; 1 km south of Grantley Adams International Airport, and 14 km east of Bridgetown, Christchurch Parish.
Area: 16 ha.
Altitude: 0-5m.
Province and type: 8.41.13; 05, 07 & 08.
Site description: A seasonal brackish lagoon and saline marshes, separated from the sea by a 120m wide belt of sand dunes. The lagoon floods with rain water during the rainy season (July to December), and dries out in February or March. Old earth banks separate the flooded area into several shallow pools. The swamp is bordered inland by limestone coral cliffs.

Principal vegetation: Halophytic vegetation; some *Conocarpus erectus*; and sand plant communities.
Land tenure: Owned by a syndicate of hunters.
Protection: None.
Land use: Waterfowl hunting during the open season (15 July to 15 October).
Waterfowl: An important area for migratory shorebirds; the commonest birds in shooting bags are *Tringa melanoleuca, T. flavipes, Arenaria interpres, Calidris alba* and *C. melanotos.* A variety of Ardeidae and shorebirds occur in small numbers in winter.
Other fauna: The endangered nominate race of the Yellow Warbler *Dendroica petechia petechia* breeds.
Threats: There is a considerable amount of disturbance from hunting during the autumn migration season, and from the nearby international airport. There are housing developments on two sides of the wetland, and a hotel may be constructed on pastureland to the southeast.
Research and conservation: Putney has identified the wetland as a site with multiple resource values, and Hutt has proposed the establishment of a wildlife sanctuary and ecosystem reserve. The plant communities in the sand dunes are of great botanical interest, and the whole area clearly merits protection.
References: Putney (1982).
Source: Maurice B. Hutt.
Criteria for inclusion: 2a, 2b & 3a.

Long Pond (3)

Location: 13°16'N, 59°34'W; on the east coast, north of Bathsheba, St. Andrew Parish.
Area: 4 ha.
Altitude: 0-3m.
Province and type: 8.41.13; 02, 05, 07 & 10.
Site description: A shallow brackish lagoon with a muddy margin, separated from the sea by a sand bar. The lagoon lies in the estuary of the Scotland River, a small stream draining the northeastern part of the island. During storms and high tides, the sand bar breaks through, allowing the ingress of sea water.
Principal vegetation: No information.
Land tenure: Privately owned.
Protection: None.
Land use: Livestock grazing and occasional hunting; some cultivation of coconuts nearby.
Waterfowl: An important area for passage shorebirds, notably *Charadrius semipalmatus, Numenius phaeopus, Tringa solitaria, Actitis macularia, Arenaria interpres, Calidris alba, C. pusilla* and *C. minutilla. Egretta caerulea* and *Ardea herodias* occur in winter.
Other fauna: No information.
Threats: The lagoon is used as an unofficial rubbish tip, and sand is extracted from the dunes to the south.
Research and conservation: A proposal for the establishment of a national park along the east coast of the island and including Long Pond is currently under consideration. All hunting and exploitation of sand would be prohibited in the park.
References: Hutt (1979).
Source: Maurice B. Hutt.
Criteria for inclusion: 2b & 3a.

BERMUDA

INTRODUCTION

adapted from a report entitled "Taking Stock of Bermuda's Wetland Heritage" prepared for this Directory by David B. Wingate

Bermuda is a group of coral limestone islands and tiny islets in the western Atlantic, about 1,200 km northwest of the Turks and Caicos Islands and 1,280 km southeast of New York. It was discovered in the 16th century, settled by the British in 1609, and has been a British Crown Colony since 1684. With an area of only 55 km^2 and a population of some 57,000, the islands have one of the highest population densities in the world.

The islands benefit from the warming effect of the Gulf Stream but lie within the zone of the westerlies which frequently attain gale force during the winter months (December to April). Hurricanes are occasional to rare between June and November. The climate is mild with temperatures ranging from 20°C to 30°C, and moderate, fairly evenly distributed rainfall averaging 1,470 mm per annum. The Colony's chief source of income is the tourist industry; international business is also important and there is some light industry, but agriculture is relatively unimportant.

The ten largest islands, comprising over 90% of Bermuda's territory, form a narrow chain now linked by causeways and bridges. The topography of the islands is rolling, with hills rising to almost 80m. Most of the islands' native forests and swamp forest have long since disappeared and there are no permanent rivers or streams, but other wetland systems are still well represented. These include the following:

a) Shallow marine bays. This is by far the largest wetland habitat in Bermuda, covering approximately 1,000 ha. However, the shallow bays are virtually sterile in terms of their ability to support waterfowl; they are used mainly by *Ardea herodias, Actitis macularia, Arenaria interpres* and *Ceryle alcyon.* Three species of sea grasses are common; *Thalassia testudinum, Cymodocea manatorum* and *Diplanthera wrightii.*

b) Rocky coastline. Bermuda has approximately 140 km of rocky coastline, but this is relatively unimportant for waterfowl other than a few shorebirds.

c) Sandy beaches. The 9 km of sandy beaches, with a rich beach wrack of sargasso weed and intertidal fauna, provide important feeding habitat for passage and wintering shorebirds, notably *Pluvialis squatarola, Arenaria interpres* and *Calidris alba.*

d) Marine tidal mudflats. Because tidal amplitudes are small (0.5-1.3m) and intertidal gradients are typically steep, the total area of intertidal mudflat is extremely small and confined to two localities, Stoke's Harbour (0.6 ha) and Spanish Point (0.8 ha). The mudflats are used mainly by *Pluvialis squatarola* and *Numenius phaeopus.*

e) Mangrove swamps. Bermuda is the most northerly site of mangrove distribution in the world. In 1980, there was a total of 16.7 ha of mangrove swamps scattered in small stands from one end of the islands to the other, in bays or inland peat basins. The largest surviving stand (2.9 ha) is at Hungry Bay, Paget. Most of the stands consist of a combination of Red Mangrove *Rhizophora mangle* and Black Mangrove *Avicennia germinans.* Buttonwood *Conocarpus erectus* is a common associate on the rocky margins of mangrove swamps. Although some mangroves swamps have been destroyed in the past (particularly in the 1940s), it is doubtful whether the total area of mangroves ever exceeded 25 ha. By 1984, 3.6 ha (22%) of mangroves were fully protected within managed nature reserves. The mangroves are particularly important for *Nyctanassa violacea* and *Ceryle alcyon.*

f) Tidal salt water ponds and lagoons. There were approximately 22 ha of enclosed tidal ponds and lagoons in Bermuda in 1900, and most of these remain essentially unchanged to this day. Only one pond (Bartram's Pond) has been filled in with rubbish, and this has since been restored as a slightly tidal brackish pond. The saline ponds are used mainly by *Podilymbus podiceps.*

g) Non-tidal fresh to brackish ponds. In 1900, there were about 7.5 ha of fresh to brackish pond habitat in Bermuda. However, wetland restoration and conservation measures initiated in 1966 at Spittal Pond and the creation of two new ponds have increased this area to 9.4 ha. The ponds typically have fringing marshes of *Typha angustifolia or Paspalum vaginatum*, submergent *Ceratophyllum demersum or Ruppia maritima*, and large populations of the introduced minnow *Gambusia affinus*. They provide breeding habitat for the small surviving populations of *Gallinula chloropus* and *Fulica americana*, and support the majority of passage and wintering *Podilymbus podiceps*, Ardeidae, Anatidae and a variety of passage shorebirds.

h) Inland peat marshes. Excluding shallow sea bays, peat marsh savannas and hammock comprise the largest portion of Bermuda's wetland habitat. This is also the habitat type which has been most extensively reduced by landfill and/or ditching. In 1900, the total area of vegetated peat marsh was 116.5 ha. Of this, 68 ha (58%) have been modified by drainage or ditching to produce arable land or wet pasture land, or destroyed completely by landfill. Although relatively poor for waterfowl, the peat marshes are of great botanical interest because the flora is almost exclusively native, in contrast to the situation elsewhere in the islands. The native flora ranges through several seral stages of development from open water ponds to peat marsh hammock. Dominant species in the early seral stages include *Typha angustifolia, Scirpus validus, Acrostichum excelsum, Cladium jamaicensis* and *Pteridium caudatum*. As the peat builds up, *Baccharis glomeruliflora* and *Myrica cerifera* bushes begin to appear, and finally hammock vegetation of *M. cerifera, Sabal bermudana* and *Juniperus bermudiana* takes over. In the early 1940s, all of the peat marshes were extensively ditched to provide better drainage into permanent water channels where *Gambusia affinus* was introduced as a biological control for mosquitos. The marshes are particularly important for *Gallinago gallinago*.

i) Farm ponds. The two or three ephemeral farm ponds, with a maximum of 0.4 ha of open water and mudflat, are extremely rich habitats attracting a large variety of shorebirds during the migration seasons.

j) Temporarily flooded meadows and arable land. After heavy rains, approximately 2 ha of low-lying marsh edge pastures, arable land, etc. may be subject to temporary flooding and thus provide feeding habitat for migratory shorebirds, notably *Tringa melanoleuca, T. flavipes, T. solitaria, Gallinago gallinago, Calidris minutilla* and *C. melanotos*.

The birds of Bermuda have been described by Wingate (1973). The number of species and individuals of waterfowl breeding on the islands is insignificant, and there are no surviving endemic species or subspecies. The endemic subspecies of *Nyctanassa violacea* became extinct in early colonial times, but the nominate race was successfully introduced between 1976 and 1978 (Wingate, 1982), and now numbers approximately 80 birds. The only other breeding species are *Anas platyrhynchos* (descendants of feral birds introduced in the 1950s), *Gallinula chloropus* and *Fulica americana*. *Podilymbus podiceps* was probably resident in pre-colonial times, but this century is known to have bred only in 1957 and 1985. On the other hand, a large number of species of waterfowl occur on passage and in winter. Bermuda lies under a West Atlantic flyway between North and South America, and although the vast majority of birds using the flyway overfly the islands, adverse weather conditions can ground significant numbers of birds. Some 45 species of waterfowl regularly overwinter, but except in the case of a few species of shorebirds, numbers are very small.

Institutional Base for Wetland Conservation and Research

Bermuda Government: Ministry of Planning, Agriculture and Fisheries. All Government-owned lands are vested in the Public Works Department, but management of wetland areas is carried out by the Conservation Division and (for marine habitats) the Fisheries Division of the Department of Agriculture and Fisheries. Both divisions are also involved in wetland research with the aim of enhancing this resource.

Bermuda National Trust. Nature reserves acquired and owned by the Bermuda National Trust are managed by the Open Spaces Committee with the advice and assistance of the Government Conservation Division.

Bermuda Audubon Society. Nature reserves acquired and owned by this Society are managed by the Society's Executive Committee with advice and assistance from the Conservation Division.

Bermuda Biological Station for Research. The Bermuda Biological Station does not own any wetland reserves, but supports an extensive laboratory facility and library with a resident scientific staff. It caters to visiting scientists from abroad, and has carried out environmental surveys and research on marine pollution and inshore water quality under contract from the Bermuda Government. In addition to the numerous research studies already published in its Contribution series, there is a very detailed study of Bermuda's fresh/brackish marsh and mangrove areas being undertaken at present by Martin Thomas of the University of New Brunswick, Canada.

Progress in Wetland Conservation

The destruction of wetlands began early in Bermuda's history, with the clearing of mangroves for boat anchorages and harbours, and conversion of peat marshes into arable land. In about 1900, the Government adopted a policy of reclaiming marshes completely in an attempt to control the mosquito problem, and in the 1930s, began to use wetlands for the disposal of garbage. After 1950, garbage disposal became the major factor in marsh reclamation and the pace of reclamation accelerated until by the late 1960s, many of the smaller ponds and peat marshes had been totally destroyed.

It was in order to fight this problem that the Bermuda Audubon Society became incorporated in 1960. This Society not only raised funds to purchase certain marshes and hold them in trust as nature reserves, but also began to turn around the public attitude toward wetland habitats. This change in attitude was favoured by the deliberate introduction in 1943 of the Top Minnow *Gambusia affinus* which quickly became a successful biological control for mosquitos and helped indirectly in the local extinction of the mosquito *Aedes egyptii*, a carrier of yellow fever.

By the early 1970s, the smaller outlying marshes were either filled in or secured as nature reserves, with the result that all of Bermuda's garbage had to be channelled into the remaining central garbage dump site in the east basin of Pembroke Marsh. The installation of a pulverization plant at that site and the opening of a dump at Castle Harbour finally made it possible to stop expanding into the remains of Pembroke Marsh. Lack of suitable disposal sites has now dictated a further technological refinement of garbage disposal, and plans are underway for a central incineration facility with ancillary recycling and compacting plants by 1987.

Thus, after decades of destruction, the future of wetland conservation in Bermuda looks bright. The aesthetic, scientific and economic value of wetlands is now generally recognized, and efforts are being made to save and restore them, not only by the voluntary conservation agencies, but also at Government level through protective planning legislation. Not only did the 1983 Development Plan designate all of the remaining wetland areas as Nature Reserves under the provisions of the Nature Reserve Zoning Category, but since 1970, the area of wetland habitat has actually increased as a result of deliberate restoration projects initiated by the Bermuda Audubon Society and the Bermuda National Trust.

Major Threats to Wetlands and Waterfowl

The major threat facing Bermuda's wetlands in the future will probably be eutrophication from increasing nutrient enrichment of the ground water. Bermuda already has one of the highest national population densities in the world, and yet there is only one sewage system serving Hamilton City, a few major hotels and the Hospital. Elsewhere, each housing unit has its own sewage pit excavated into the limestone bedrock. As housing densities have increased, nutrient enrichment of the groundwater from cesspits has increased correspondingly. It is possible, however, that the increasing need to exploit groundwater to augment domestic water supplies will dictate more general use of sewage collection and treatment systems before wetland pollution becomes critical.

At Spittal Pond, the growing problem of eutrophication has been aggravated further by sheet run-off containing manure from an adjacent badly overgrazed dairy farm. By the mid 1970s, the problem had become so severe that summer die-off of the fish populations became routine. In 1979, a 30 cm diameter flushing valve was installed to deal with this problem. It is connected to the sea below low-tide level, and makes it possible to flush the pond, using the tides as the pumping mechanism, whenever this becomes necessary. Although not a solution to the problem, it has at least enabled the water quality to recover somewhat.

Hunting pressure was high in colonial times, and undoubtedly led to the rapid extinction of some unusually tame endemic species or subspecies, such as the local Yellow-crowned Night Heron *Nyctanassa violacea*. However, all hunting was prohibited in Bermuda in 1943, and a total ban on firearms, imposed in 1973 and continued with minor exceptions ever since, has put a stop to illegal hunting.

WETLANDS

Site descriptions based on data sheets provided by David B. Wingate, Conservation Officer at the Department of Agriculture and Fisheries. (For map, see Anguilla.)

Lover's Lake (1)

Location: 32°22'N, 64°42'W; Ferry Point West, St. George's Island.
Area: 0.65 ha.
Altitude: 0.1m.
Province and type: 8.38.13; 07 & 08.
Site description: A saline pond, up to 4m deep, with fringing mangrove swamps. The water level rises and falls with the tides via underground channels.
Principal vegetation: Black Mangroves *Avicennia germinans*; submergent beds of *Ruppia maritima and Thalassia testudinum*; some *Salicornia* sp and *Sesuvium portulacastrum.*
Land tenure: Owned by the Government of Bermuda.
Protection: A Nature Reserve established in 1980, and an integral part of a larger National Park.
Land use: None.
Waterfowl: A wintering area for *Podilymbus podiceps* and *Nyctanassa violacea.*
Other fauna: A wintering area for *Ceryle alcyon.* The pond is an important sanctuary for the endemic Killifish *Fundulus bermudae*, and has an interesting invertebrate fauna.
Threats: None foreseen.
Research and conservation: The only inland water body in Bermuda in which the minnow *Gambusia affinus* has not been introduced. Reafforestation of the area surrounding the lake with native flora would be desirable.
Source: David B. Wingate.
Criteria for inclusion: 2a & 2b.

Trott's Pond and Mangrove Lake (2)

Location: 32°19'N, 64°42'W; adjacent to Paynter's Road, Tucker's Town.
Area: Trott's Pond 4.0 ha; Mangrove Lake 12.3 ha.
Altitude: 0.2m.
Province and type: 8.38.13; 07 & 08.
Site description: Two saline lakes, up to 2m deep, with fringing mangroves; subject to slight tidal fluctuations.
Principal vegetation: Mangroves *Avicennia germinans* and *Rhizophora mangle*; submergent beds of *Ruppia maritima.*
Land tenure: Bermuda Properties Limited (a private golf club) owns Trott's Pond and most of Mangrove Lake; the Bermuda National Trust owns the west end of Mangrove Lake.
Protection: The west end of Mangrove Lake is in a Nature Reserve; the rest of the wetland area was zoned as a nature reserve in the 1983 Development Plan, but no conservation measures have as yet been taken.
Land use: None.
Waterfowl: A wintering area for *Podilymbus podiceps, Nyctanassa violacea, Butorides virescens, Aythya collaris, A. affinis, Gallinula chloropus* and *Fulica americana.*
Other fauna: A wintering area for *Seiurus noveboracensis.* The lakes support the largest remaining populations of the endemic Killifish *Fundulus bermudae.* The introduced minnow *Gambusia affinus* is abundant, and there is an interesting invertebrate fauna.
Threats: Eutrophication and possible pollution from fertilizers, pesticides and herbicides used on the adjacent golf course.
Research and conservation: The lakes have been studied in connection with the geological processes of "gytta" and oil formation, and constitute an important visual amenity.
References: Hayward *et al* (1981).
Source: David B. Wingate.
Criteria for inclusion: 2a & 2b.

Shelly Bay Marsh (3)

Location: 32°20'N, 64°44'W; Shelly Bay, Hamilton Parish.
Area: 1.8 ha.
Altitude: 0.1m.
Province and type: 8.38.13; 07 & 08.
Site description: A small saline lagoon, up to 2.5m deep, and salt marsh with extensive mangrove swamps. The water level rises and falls with the tides via underground channels.
Principal vegetation: Red Mangroves *Rhizophora mangle, Salicornia sp, Paspalum vaginatum* and *Fimbristylis castanea.*
Land tenure: Owned by the Government of Bermuda.
Protection: A Nature Reserve, established in 1970.
Land use: In 1970, part of the marsh was filled in, and this area is now a playing field. There is still some illegal dumping of rubbish.
Waterfowl: A wintering area for Ardeidae, *Fulica americana, Porzana carolina* and other Rallidae.
Other fauna: A wintering area for *Ceryle alcyon* and *Seiurus noveboracensis.*
Threats: There are some minor problems from illegal dumping of rubbish and human disturbance.
Research and conservation: One of the few tidal salt marshes in Bermuda. The open water area was enlarged and deepened by dragline in 1970.
Source: David B. Wingate.
Criteria for inclusion: 3a.

Spittal Pond (4)

Location: 32°18'N, 64°43'W; South Shore, Smith's Parish.
Area: 3.9 ha.
Altitude: 0.5m.
Province and type: 8.38.13; 07 & 13.
Site description: A permanent shallow brackish lagoon with fringing mudflats and marshes. The water level fluctuates by about 75 cm with rainfall and periodic flooding from the sea, and mudflats are exposed at low water levels. Two small freshwater ponds were excavated in 1966.
Principal vegetation: Submergent beds of *Ruppia maritima* and fringing *Paspalum vaginatum.*
Land tenure: Owned by the Bermuda National Trust. The Bermuda Government owns and manages the surrounding land as a National Park.
Protection: A Nature Reserve established in 1954; part of a National Park.
Land use: Bird-watching and hiking; some livestock grazing.
Waterfowl: About 40 pairs of feral *Anas platyrhynchos* breed. The pond is a major refuge for passage shorebirds, notably species of *Tringa, Limnodromus* and *Calidris*, and a wintering area for *Podilymbus podiceps, Egretta caerulea, E. tricolor, E. thula, E. alba, Anas rubripes, A. crecca, A. americana, A. discors, Aythya collaris, A. affinis* and *Fulica americana.*
Other fauna: The introduced minnow *Gambusia affinus* is abundant, and plays an important role both in the biological control of mosquitos and as a prey species for Ardeidae. The eel *Anguilla anguilla* is common, and mullet *Mugil* sp occasionally become established after severe hurricane flooding.
Threats: There is some eutrophication from run-off from an adjacent dairy farm, and occasional botulism in summer.
Research and conservation: An important area for outdoor recreation and educational tours, with interesting geological features.
References: Hayward *et al* (1981).
Source: David B. Wingate.
Criteria for inclusion: 3a.

Devonshire Marshes (5)

Location: 32°18'N, 64°45'W; between Vesey Street/Parson's Road and Middle Road/Jubilee Road, Devonshire Parish.
Area: 28.3 ha (eastern section 19.6 ha, western section 8.7 ha).
Altitude: 0.5m.
Province and type: 8.38.13; 13, 16, 18 & 19.
Site description: Two large peat marsh basins, lacking open water except in mosquito control ditches; with sawgrass swamp, bracken savanna, wet pasture and, in the western section, swamp forest. The marshes are periodically flooded by heavy rains, and the water is almost fresh (salinity 4 p.p.t.). The eastern and western sections are separated by a narrow strip of dry ground with a highway. The marsh basin lies within Bermuda's largest freshwater lens.
Principal vegetation: Extensive stands of sawgrass *Cladium jamaicensis*, bracken fern *Pteridium caudatum* and *Osmunda* ferns, with scattered *Myrica cerifera, Ilex vomitoria* and small patches of *Juniperus bermudiana* and *Sabal bermudana* swamp forest including the naturalized palm *Phoenix reclinata.* Marsh edge pastures are dominated by *Paspalum urvillei* and *Panicum purparescens.*
Land tenure: The eastern section is partly privately owned and partly owned by the Bermuda Audubon Society and the Bermuda National Trust; the western section is privately owned.
Protection: Part of the eastern section has been acquired as a Nature Reserve; the rest of the wetland was zoned as a nature reserve in the 1983 Development Plan, but no other conservation measures have been taken.
Land use: Livestock grazing and the cutting of grass for fodder. Fresh water is extracted from filtration galleries around the marsh edge for domestic use.
Waterfowl: An important area for some passage and wintering waterfowl, notably *Botaurus lentiginosus, Bubulcus ibis, Butorides virescens, Egretta caerulea, Plegadis falcinellus, Porzana carolina* and *Gallinago gallinago.*
Other fauna: A variety of introduced species occur in the marsh, including the Orange-cheeked Waxbill *Estrilda melpoda*, the toad *Bufo marinus*, and the frogs *Eleutherodactylus johnstonei* and *E. gossei.*
Threats: The future exploitation and land use of the marsh is still in dispute.
Research and conservation: The largest of the peat marsh basins in Bermuda, and one which has never been used for the dumping of rubbish. A portion of the western section retains virgin stands of the endemic Bermuda Cedar and Bermuda Palmetto forest. It is recommended that the entire marsh be acquired as a nature reserve and water conservation area.
References: Hayward *et al* (1981).
Source: David B. Wingate.
Criteria for inclusion: 2b & 3a.

Pembroke Marsh East (6)

Location: 32°18'N, 64°47'W; on the north edge of Hamilton City, Pembroke Parish.
Area: 5.8 ha.
Altitude: 0.5m.
Province and type: 8.38.13; 13.
Site description: An extensive freshwater *Typha* swamp with some open water channels; up to 3m deep. There are only slight fluctuations in water level. The channels were extended by draglining in 1979.
Principal vegetation: Mainly *Typha angustifolia* with some *Ceratophyllum demersum* and *Cladium jamaicensis.*
Land tenure: Owned by the Government of Bermuda.
Protection: Zoned as a nature reserve in the 1983 Development Plan.
Land use: There is a rubbish dump on land adjacent to the marsh.
Waterfowl: A minimum of 6 pairs of *Gallinula chloropus* and 1 or 2 pairs of *Fulica americana* breed; *Podilymbus podiceps* bred in 1957. A wide variety of waterfowl have been recorded on passage and in winter, including *Podilymbus podiceps, Botaurus lentiginosus, Ixobrychus exilis, Nycticorax nycticorax, Butorides virescens, Ardea herodias, Anas crecca, A. discors, Aythya collaris, A. affinis, Porzana carolina* and *Porphyrula martinica.*

Other fauna: The introduced minnow *Gambusia affinus* occurs.
Threats: Pollution from windblown refuse and leaching from the neighbouring rubbish dump.
Research and conservation: An important green belt and visual amenity on the boundary of Hamilton City. The future status and boundaries of the proposed nature reserve have not as yet been established. The adjacent rubbish dump could be phased out and the land used for recreational parkland and playing fields.
References: Hayward *et al* (1981).
Source: David B. Wingate.
Criteria for inclusion: 3a.

Hungry Bay Mangrove Swamp (7)

Location: 32°17'N, 64°45'W; Hungry Bay, South Shore, Paget East.
Area: 2.9 ha.
Altitude: 0m.
Province and type: 8.38.13; 01 & 08.
Site description: A tidal mangrove swamp, up to 1m deep at high water, in a shallow sea bay with a relatively narrow opening to the sea.
Principal vegetation: Mangrove swamps with *Avicennia germinans, Conocarpus erectus* and *Rhizophora mangle*; some *Salicornia* sp.
Land tenure: The ownership is in dispute; either owned by the Government of Bermuda or by two private estates.
Protection: Zoned as a nature reserve in the 1983 Development Plan. A Tree Preservation Order protects the mangroves.
Land use: Some recreational use of the tidal channels by boat traffic.
Waterfowl: A wintering area for *Nyctanassa violacea.*
Other fauna: *Ceryle alcyon* and *Seiurus noveboracensis* are winter residents. The swamp supports the only significant surviving populations of the Giant Land Crab *Cardisoma guanhumi* and Land Hermit Crab *Cenobita* sp on Bermuda. The Mangrove Crab *Goniopsis cruentatus* also occurs.
Threats: Channels have been cut through the mangroves to enable boats to reach private properties bordering the swamp.
Research and conservation: The largest mangrove swamp in Bermuda, and one of Bermuda's largest and most interesting natural areas. It is recommended that the mangrove swamp and the peninsula of land between the swamp and the sea be acquired and managed as a nature reserve.
References: Hayward *et al* (1981).
Source: David B. Wingate.
Criteria for inclusion: 2b & 3a.

Paget Marsh Nature Reserve (8)

Location: 32°16'N, 64°46'W; adjacent to Middle Road, Paget Parish.
Area: 8.8 ha.
Altitude: 0.5m.
Province and type: 8.38.13; 08, 16 & 18.
Site description: A complex of swamp forest, marshy savanna and mangrove swamp with a perimeter drainage ditch; up to 1.5m deep and with a salinity of 6 p.p.t. The water level rises and falls slightly with the tides and rainfall.
Principal vegetation: Swamp forest with the endemic Bermuda Cedar *Juniperus bermudiana* and the endemic Bermuda Palmetto *Sabal bermudana*; *Myrica cerifera* bushes; marshes with *Cladium jamaicensis, Typha angustifolia, Scirpus americanus*, the endemic sedge *Carex bermudiana*, and *Acrostichum excelsum*; and mangrove swamps with *Rhizophora mangle.*
Land tenure: Owned by the Bermuda National Trust and the Bermuda Audubon Society.
Protection: A Nature Reserve, established between 1955 and 1966.

Land use: Nature-oriented recreation; there is a nature trail for educational guided tours and self-guiding tours. Some virgin forest was cut in 1983 in a timber stealing operation.
Waterfowl: Of very little importance for waterfowl. *Butorides virescens, Anas discors, Porzana carolina, Gallinula chloropus* and *Gallinago gallinago* occur on passage and in winter.
Other fauna: A variety of introduced species occur, including the Orange-cheeked Waxbill *Estrilda melpoda*, the toad *Bufo marinus*, and the frogs *Eleutherodactylus johnstonei* and *E. gossei.*
Threats: The threat of timber theft continues as living and dead cedars within the reserve are of great value.
Research and conservation: The largest surviving remnant of Bermuda's pre-colonial swamp forest, and of primary importance as a reserve for native marsh flora. It is the most important locality for the endemic Bermuda Sedge *Carex bermudiana*, and is rich in fungi. All non-native species of flora are being culled to preserve this remnant of forest in its natural condition. The ditch surrounding the marsh could be widened in places to form ponds without any damage to the native flora.
References: Hayward *et al* (1981).
Source: David B. Wingate.
Criteria for inclusion: 2a, 2b & 3a.

Warwick Pond (9)

Location: 32°16'N, 64°48'W; adjacent to Middle Road, Warwick Parish.
Area: 2.3 ha.
Altitude: 0.5m.
Province and type: 8.38.13; 13.
Site description: A shallow freshwater pond, up to 20 cm deep, with mudflats at the north end and a broad fringing marsh. There are slight fluctuations in water level associated with the tides.
Principal vegetation: Mainly *Paspalum vaginatum* with some *Scirpus americanus* and *Fimbristylis castanea.*
Land tenure: Privately owned (Graham Powell Estate).
Protection: Zoned as a nature reserve in the 1983 Development Plan.
Land use: Livestock grazing on the edge of the marsh.
Waterfowl: *Gallinula chloropus* bred in 1984. The mudflats at the north end of the pond are an important feeding area for passage shorebirds, notably *Charadrius semipalmatus, Tringa melanoleuca, T. flavipes, Calidris pusilla, C. minutilla, C. fuscicollis, C. melanotos* and *Micropalama himantopus.* Wintering birds include *Podilymbus podiceps*, various Ardeidae, *Anas discors, Porzana carolina* and *Fulica americana.*
Other fauna: The endemic Killifish *Fundulus bermudae* occurs. Warwick Pond is the only freshwater pond in which this species occurs and it is likely that the form occurring here is unique to the pond.
Threats: None known.
Research and conservation: M. Thomas is conducting a detailed study of the pond. It is recommended that the area be acquired by the Bermuda National Trust or Government for a nature reserve. Possible management could include deepening of the south end of the pond by dredging, and introduction of *Ruppia maritima.*
References: Hayward *et al* (1981).
Source: David B. Wingate.
Criteria for inclusion: 2a, 2b & 3a.

Somerset Long Bay Pond (10)

Location: 32°18'N, 64°52'W; Long Bay Lane, Somerset Island, Sandy's Parish.
Area: 0.4 ha.
Altitude: 0.5m.
Province and type: 8.38.13; 13.

Site description: A freshwater pond, up to 2m deep, with three small islands and scattered mangroves. The pond was recreated in 1973 by dredging on the site of an old rubbish dump, and deepened in 1980. There are slight changes in water level with rainfall, and the salinity is 4 p.p.t.
Principal vegetation: Scattered Black Mangroves *Avicennia germinans* on the islets, fringing *Paspalum vaginatum*, and submergent beds of *Ruppia maritima.*
Land tenure: Acquired by the Bermuda Audubon Society in 1970.
Protection: Protected as a Nature Reserve by the Bermuda Audubon Society since 1970.
Land use: Recreation on the adjacent public beach. The grass around the pond is periodically cut for cattle fodder.
Waterfowl: Long Bay Pond and the nearby private Pitman's Pond are becoming the most important breeding area for *Gallinula chloropus* and *Fulica americana* in Bermuda, and *Podilymbus podiceps* bred in 1985. A variety of waterfowl occur in winter, including *P. podiceps*, several Ardeidae, *Anas discors, Aythya collaris* and *Porzana carolina.*
Other fauna: The minnow *Gambusia affinus* was introduced in 1973 and is now abundant.
Threats: There is some minor disturbance from people using the adjacent beach. The area has been fenced off to reduce public disturbance, but the fencing and boundary hedges should be improved.
Research and conservation: Long Bay Pond forms an integral part of a public beach and park area. It lies in the Somerset freshwater lens, and is particularly rich because of the exceptional freshness of its water.
References: Hayward *et al* (1981).
Source: David B. Wingate.
Criteria for inclusion: 2b.

Other significant wetlands

Other significant wetlands in Bermuda include the following:

Bartram's Pond, St. George's Island (0.4 ha): a brackish pond, up to 2m deep, with two islets excavated in 1983, submergent *Ruppia maritima* and fringing *Paspalum vaginatum.* Owned and managed as a Nature Reserve by the Bermuda Audubon Society.

Cloverdale Marsh, Devonshire East (0.25 ha): a man-made, slightly brackish pond, up to 1.5m deep, excavated within a peat marsh; with *Typha angustifolia, Cladium jamaicensis* and *Conocarpus erectus.* Owned by the Cloverdale Condominium Owners Association, and managed as a Water Garden and private Nature Reserve. *Gallinula chloropus* breeds.

Edmund Gibbons Nature Reserve, Devonshire East (1.8 ha): a slightly brackish swamp, up to 2m deep, with native swamp "hammock" flora including *Juniperus bermudiana, Sabal bermudana, Myrica cerifera, Typha angustifolia, Cladium jamaicensis* and *Conocarpus erectus.* Owned by the Bermuda National Trust and managed as a Nature Reserve. *Gallinula chloropus* breeds.

Seymour's Pond, Southampton Parish (0.2 ha): a shallow, slightly brackish pond, up to 0.5m deep, with submergent *Ruppia maritima* and fringing *Paspalum vaginatum.* Owned by the Bermuda Audubon Society and managed as a Nature Reserve since 1963. *Gallinula chloropus* breeds.

Evan's Pond, Southampton West (1.8 ha): an enclosed saline pond, up to 3m deep, with fringe of mangroves *Avicennia germinans* and *Rhizophora mangle.* Owned by the Government of Bermuda and two private estates; zoned as a nature reserve in the 1983 Development Plan. A roosting site for Ardeidae.

Ireland Island Lagoon, Ireland Island South (2.4 ha): a saline lagoon with fringing mangroves *Avicennia germinans* and *Rhizophora mangle*, and Turtle Grass *Thalassia testudinum*; connected with the sea by a channel and subject to tidal influence. Owned by the Government of Bermuda (West End Development Corporation), and zoned as a nature reserve in the 1983 Development Plan. A roosting site for Ardeidae.

BRITISH VIRGIN ISLANDS

INTRODUCTION

No information was received on the current situation in the British Virgin Islands. The following account is based on CCA/ECNAMP (1981), Lettsome (1981), IUCN (1982 & 1983), Putney (1982) and Goodwin *et al* (1984).

The Virgin Islands are a group of small islands between Puerto Rico and the Leeward Islands. The smaller eastern group comprises the British Virgin Islands, a British Crown Colony of 153 km^2, while the larger western group is a United States Territory. The forty or so islands, rocks and cays in the British Virgin Islands are all of volcanic origin except for Anegada, a low-lying island of coral and limestone to the northeast of the main group. The population of about 12,000 is concentrated on the four main islands, Tortola, Virgin Gorda, Anegada and Jost Van Dyke, and most of the smaller islands are uninhabited. The economy of the islands is heavily based on tourism.

The climate is dry subtropical, with maximum summer temperatures of about 30°C, minimum winter temperatures of 19°C, and an average annual rainfall of less than 1,200 mm in most areas. The dominant natural vegetation is cactus scrub and dry woodland, but on the main islands, much of this has been modified by grazing or lost to urban development. Much the largest wetland in the British Virgin Islands is a complex of saline lagoons and mangrove swamps at the west end of Anegada. However, there are over twenty smaller lagoons and salt ponds, and about twenty-five stands of mangroves scattered throughout the islands. The ponds are of considerable importance as feeding areas for migratory shorebirds, and the mangrove swamps provide feeding and nesting areas for a variety of Ardeidae, and nursery grounds for many commercially important fishes and crustaceans, such as *Megalops atlantica, Lutjanus griseus, Caranx hippos, Epinephelus itajara* and *Panulirus argus*. Some of the mangrove fringed lagoons also provide safe shelters for boats during hurricanes and tropical storms. There are many long sandy beaches important for nesting sea turtles, several islets and cays with sea-bird colonies, and extensive offshore coral reefs and beds of sea grasses (*Thalassia testudinum, Syringodium filiforma* and *Diplanthera wrightii*) throughout the archipelago.

Institutional Base for Wetland Conservation and Research

The Ministry of Natural Resources is the governmental body responsible for conservation. The National Parks Trust, based in Tortola, was established in 1961 as a Statutory Body under the portfolio of the Ministry of Natural Resources. It is responsible for the development and management of national parks, marine parks and other reserves, and is currently establishing a Botanic Garden and Museum.

The British Virgin Islands Conservation Society was established in 1978 to promote historical and cultural development and preservation of the environment. It is doubtful, however, if this society is still active.

Progress in Wetland Conservation and Research

The National Parks Ordinance of 1961 and the Marine Parks and Protected Areas Ordinance of 1979 provide the legal basis for the establishment of national parks, marine parks and other protected areas. Other relevant legislation includes the Endangered Animals and Plants Ordinance (1976), Wild Birds Protection Ordinance, Salt Ponds Ordinance, and Protection of Trees and Conservation of Soil and Water Ordinance. Eleven terrestrial protected areas and one marine park had been established by the end of 1980. Only one of these contains any significant wetland habitat, namely the Flamingo Pond Bird Sanctuary (449 ha) at the west end of Anegada, established in 1977. Many other areas have been proposed for protection; those incorporating wetlands include large reserves at the east end of Anegada and off the north coast of Virgin Gorda.

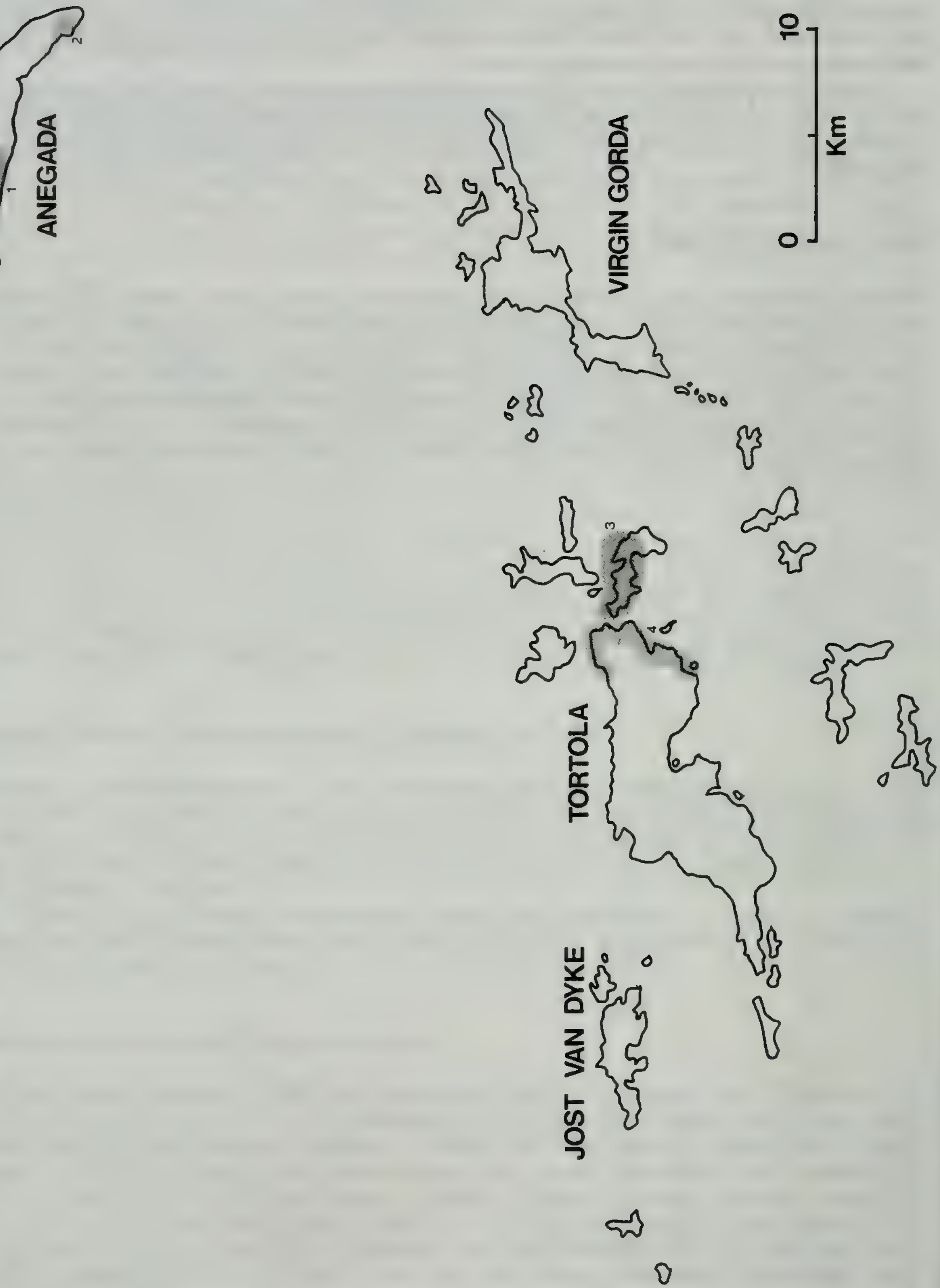
A Parks and Protected Areas Project is currently being executed by the National Parks Trust and the Eastern Caribbean Natural Area Management Programme (ECNAMP), with funding from Jackson Hole Preserve, Inc. This aims to develop a system of parks and protected areas in which the utilization of marine and coastal resources is consistent with national objectives for development. The eight areas so far designated for management are all shallow marine areas and small offshore islands; they include areas important for fisheries production, sea turtles and nesting sea-birds.

Research has focussed primarily on the marine resources of the islands, but Lettsome (1981) has prepared an inventory of critical terrestrial ecosystems and mangrove areas, and Goodwin *et al* (1984) have studied salt ponds with a view to assessing their potential for mariculture.

Major Threats to Wetlands

Most of the wetlands in the British Virgin Islands are under threat. Several salt ponds and mangrove communities have already been lost to development, and by 1981, of the twenty stands of mangroves known on Tortola, only four remained in an unaltered condition. Threats include land reclamation for development, dredging for marina construction, sand mining, the dumping of solid waste and the cutting of mangroves for timber, fuel and animal fodder. Two of the three salt ponds on Virgin Gorda have recently been opened to the sea and dredged or partly filled for tourist development, and at least three of the six ponds on Tortola are under imminent threat.

BRITISH VIRGIN ISLANDS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WETLANDS

Site descriptions based on the literature, principally Lettsome (1981), Putney (1982) and Goodwin *et al* (1984).

Flamingo Pond Bird Sanctuary (1)

Location: 18°44'N, 64°22'W; at the west end of Anegada Island.
Area: 449 ha.
Altitude: 0-5m.
Province and type: 8.41.13; 07 & 08.
Site description: A complex of interconnected saline lagoons (Flamingo Pond, 225 ha; Bones Bight Pond, 25 ha; and Red Pond, 150 ha), with several small islands and a single narrow connection with the sea. The lagoons, which are less than 1m deep, are subject to slight tidal influence, and there are some mangrove swamps in tidal areas near the coast. Salinities of 55-87 p.p.t. were recorded in January 1984.
Principal vegetation: Mangrove swamps with *Avicennia germinans, Laguncularia racemosa* and *Rhizophora mangle*; cactus scrub and dry woodland in surrounding areas.
Land tenure: The ponds and the land to the south are state owned; land to the north is privately owned.
Protection: Protected as the Flamingo Pond Bird Sanctuary (449 ha) established in 1977.
Land use: Some fishing in the mangroves; grazing in surrounding areas and a little tourism along the adjacent coast.
Waterfowl: A very important area for migratory waterfowl, particularly shorebirds. *Phoenicopterus ruber* was formerly a regular winter visitor, but few have been reported in recent years.
Other fauna: The endemic *Iguana pinguis* and the worm snake *Typhlops catapontus* occur in the reserve, and fish are present in the lagoons.
Threats: None known.
Research and conservation: Much the largest wetland in the British Virgin Islands; identified by Putney as one of the largest remaining saline lagoons in relatively unaltered condition in the Lesser Antilles.
References: Lettsome (1981); IUCN (1982); Putney (1982); Goodwin *et al* (1984).
Source: See references.
Criteria for inclusion: 2b & 3a.

East End Pond (2)

Location: 18°42'N, 64°17'W; at the eastern tip of Anegada Island.
Area: c.100 ha.
Altitude: 0m.
Province and type: 8.41.13; 07 & 08.
Site description: A saline lagoon 60 ha in extent and up to 20 cm deep, with open connection to the sea, mangrove swamps along the south, west and east shores and along the adjacent coast, and limestone pavement to the north. A salinity of 26 p.p.t. was recorded in January 1984.
Principal vegetation: Mangrove swamps with *Rhizophora mangle*; cactus scrub in surrounding areas.
Land tenure: The ponds and land to the north are state owned; land to the south and east is privately owned.
Protection: None.
Land use: Some grazing of domestic livestock in surrounding areas.
Waterfowl: No information.
Other fauna: An important nursery ground for juvenile fishes and crustaceans.
Threats: None known.

Research and conservation: Within a proposed protected area including the eastern end of Anegada and adjacent marine areas.
References: Putney (1982); Goodwin *et al* (1984).
Source: See references.
Criteria for inclusion: 3a.

Wetlands of Beef Island (3)

Location: 18°27'N, 64°32'W; on the western half of Beef Island, off the east end of Tortola.
Area: c.35 ha.
Altitude: Near sea level.
Province and type: 8.41.13; 05, 07 & 08.
Site description: Five shallow saline ponds behind sea beaches: Goose Hole Pond (14 ha), Bluff Bay Pond (7 ha), Trellis Bay Pond (2 ha), Sprat Point (Banana Wharf) Pond (4 ha) and Conch Bay Pond (4 ha); and a small mangrove swamp at Hans Creek. There are mangroves at all the ponds except Sprat Point; Goose Hole and Trellis Bay Ponds occasionally dry out completely; and Goose Hole Pond is open to the sea via a culvert. Salinities of 20-37 p.p.t. were recorded at the ponds in November 1983.
Principal vegetation: Mangrove swamps with *Avicennia germinans*, *Laguncularia racemosa* and *Rhizophora mangle*, and beach vegetation with the rare *Coccoloba swartziae*; coastal woodland, cactus scrub and some grassland in surrounding areas.
Land tenure: Mainly privately owned; Conch Bay Pond is state owned.
Protection: Sprat Point Pond is protected by the government because of the great botanical interest of the adjacent native coastal woodland. Other areas are unprotected.
Land use: The mining of sand for construction purposes at Bluff Bay Pond, and the harvesting of salt at Conch Bay Pond and Sprat Point Pond. There is a large airport near Conch Bay Pond, and a popular recreation beach to the north.
Waterfowl: An important nesting area for Ardeidae and feeding area for a variety of waterfowl, notably migratory shorebirds.
Other fauna: The brine shrimp *Artemia* sp occurs in Conch Bay Pond, and sea turtles nest on the nearby beaches.
Threats: None known, other than some disturbance from tourist recreation, and sand mining activities at Bluff Bay Pond.
Research and conservation: Sprat Point Pond and Hans Creek have been identified by Lettsome as critical areas for protection. The government is considering purchasing Goose Hole Pond in order to preserve it.
References: Lettsome (1981); Putney (1982); Goodwin *et al* (1984).
Source: See references.
Criteria for inclusion: 3a.

Wetlands of Eastern Tortola (4)

Location: 18°27'N, 64°34'W; around the eastern end of Tortola, from Josiah's Bay to Paraquita Lagoon.
Area: c.30 ha.
Altitude: 0m.
Province and type: 8.41.13; 05, 07 & 08.
Site description: A shallow brackish lagoon of 8 ha, Josiah's Bay Pond, with fringing mangrove swamps and brackish marshes behind a sea beach; and three coastal mangrove swamps: Paraquita Lagoon, Fat Hogs Bay and Beef Island Channel. Josiah's Bay Pond has been connected to the sea by a channel to allow partial drainage during periods of heavy rainfall; a salinity of 7 p.p.t. was recorded in November 1983.
Principal vegetation: Mangrove swamps with *Avicennia germinans*, *Laguncularia racemosa*, *Conocarpus erectus* and *Rhizophora mangle*, and brackish marshes; dry woodland and scrub in surrounding areas.
Land tenure: Mainly privately owned.

Protection: None.
Land use: Livestock grazing in the marshes around Josiah's Bay Pond. Paraquita Lagoon, Fat Hogs Bay and Beef Island Channel provide safe shelters for boats during hurricanes and tropical storms.
Waterfowl: An important area for resident Ardeidae and migratory shorebirds.
Other fauna: The mangrove swamps are nursery grounds for juveniles of marine fishes and lobsters *Panulirus argus*, and mullet *Mugil* sp occur in Josiah's Bay Pond.
Threats: The dumping of solid waste and wood-cutting at Paraquita Lagoon; land reclamation for development, erosion and wood-cutting at Fat Hogs Bay; and wood-cutting at Josiah's Bay Pond.
Research and conservation: All four areas have been identified by Lettsome as critical areas in need of protection.
References: Lettsome (1981); Putney (1982); Goodwin *et al* (1984).
Source: See references.
Criteria for inclusion: 3a.

Other wetlands

Other important wetlands include the following:

Brandy Point Pond, Prickly Pear Cay; a small saline pond with mangroves (*Avicennia germinans* and *Laguncularia racemosa*), rich in wildlife.

South Sound Mangroves, Virgin Gorda; one of the few unspoiled mangrove systems in the islands.

Pond Bay Salt Pond, Virgin Gorda; a small brackish pond with mangroves (*Avicennia germinans* and *Rhizophora mangle*), behind a sea beach. State owned; the surrounding land is leased to a resort corporation which apparently intends to retain the pond in an undeveloped state.

Sea Cow Bay, Tortola; one of the largest mangrove systems in the islands, with *Avicennia germinans*, *Laguncularia racemosa* and *Rhizophora mangle*. An important nursery ground for marine fishes and crustaceans, and a shelter for boats during storms. Threatened by the dumping of solid waste, land reclamation for development, and wood-cutting.

Cane Garden Pond, Tortola; a brackish pond with fringing mangroves (*Avicennia germinans* and *Laguncularia racemosa*), behind a sea beach. Rich in bird life, and identified by Lettsome as a critical area for protection, but used as a rubbish dump and polluted with domestic sewage. The owners have requested permission to fill the pond.

Belmont Pond, Tortola; a saline pond with fringing mangroves (*Avicennia germinans* and *Laguncularia racemosa*), behind a sea beach. Identified by Lettsome as a critical area for protection.

East End Harbour, Jost Van Dyke; one of the largest mangrove systems in the islands, and an important nursery ground for marine fishes and crustaceans.

References: Lettsome (1981); Putney (1982); Goodwin *et al* (1984).

THE CAYMAN ISLANDS

INTRODUCTION

by **Patricia Bradley**

The Cayman Islands are three low-lying oceanic islands totalling some 263 km^2 in extent at the extreme western end of the Greater Antilles in the Caribbean Sea. The islands are emergent peaks of the Cayman Ridge, a range of submarine mountains extending from Cuba to the Mysteriosa Bank in Honduras. The islands lie approximately 240 km south of Cuba and 280 km northeast of Jamaica. They are surrounded by steep ocean trenches; the Bartlett Trough southeast of Grand Cayman attains a depth of 6,000m.

Grand Cayman (197 sq. km), the largest and most westerly island, lies 86 km west-southwest of Little Cayman (28 sq. km), which lies 7 km due west of Cayman Brac (38 sq. km). Grand Cayman and Little Cayman are encircled by extensive coral reefs enclosing areas of shallow water; the largest is the 60 sq. km North Sound, Grand Cayman. The islands each have a central core of Bluff limestone of mid-Miocene to Oligocene origin, believed to be over 400 m thick, and a low (3-4m) coastal platform of Pleistocene ironshore, a marine consolidation of sand, lagoonal mud, coral and molluscs. The modern mangrove ecosystems developed during the Holocene, and are underlain by peats, plastic muds and bedrock. Rivers and streams are absent.

The Cayman Islands, at a latitude between 19°N and 20°N, are in the heart of the northeast trade wind belt which dominates the Caribbean. This stable wind system, in conjunction with the moderating influence of the sea on very small land masses, makes for a relatively unchanging climate, modified only by small seasonal variation, by the regular intrusion of cold fronts moving south from the U.S.A. during the winter, and by the occasional tropical storm or hurricane during the summer and autumn months.

Rainfall occurs principally in the summer months, commencing usually in May, and rising to a maximum in October. The Grand Cayman average annual rainfall for the period 1974-1983 was 133 cm. Cayman Brac is significantly drier, with an annual average of 122 cm in the wettest central zone.

Tidal fluctuation is of low amplitude, characteristic for the Western Caribbean, and normally in the range 12 to 50 cm. The fluctuation pattern is of the mixed diurnal/semidiurnal type, usually dominated by the semidiurnal component. Average sea water level shows a degree of seasonal variation with a tendency to higher levels in the summer months: this, in conjunction with the seasonal distribution of rainfall, is reflected in the flooding of the extensive mangrove swamps of Grand Cayman, which usually dry out during the winter, and often remain flooded for long periods during the summer. The strong northerly winds associated with winter cold fronts may however bank water in the North Sound sufficiently to cause extensive mangrove inundation at times of relatively low average sea level.

Long term periodicity in mean sea level is becoming apparent as tide records are extended over the years; this involves an amplitude of the order of 10 cm.

The Cayman Islands have been settled since 1666. In 1863, the islands were annexed to Jamaica under the British Colonial System, and they remained so until 1962 when Jamaica became independent and the Cayman Islands were proclaimed a Crown Colony. Caymanians have a close affinity with the sea, and crafts include boat building and rope weaving. The main agricultural production is fruit, vegetables, cattle, goats and poultry. In 1979, population estimates for the three islands were: Grand Cayman 15,000; Cayman Brac 1,600; and Little Cayman 74. Over 200,000 tourists visited the islands in 1983.

The wetlands of the Cayman Islands show patterns typical of tropical ecosystems, namely seasonal rainfall and great fluctuations in water level due to evapotranspiration; tidal influence is also a significant factor. The six wetland ecosystems present are as follows:

Mangrove swamps
Conocarpus swamps
Typha swamps
Sedge swamps
Seasonal pools on flooded grassland
Coastal systems

a) Mangrove swamps cover 36% of Grand Cayman, 40% of Little Cayman and 1% of Cayman Brac. A number of brackish to highly saline ponds are associated with the mangroves; the majority of these are seasonal. The mangrove ecosystem has been divided into seven communities (Woodroffe 1979): *Avicennia* forest; pioneer, low marine, tall marine, and non-marine *Rhizophora*; mixed mangrove forest; and *Laguncularia/Conocarpus* woodland. A major gap in knowledge of the wetland ecosystems of the Cayman Islands is any understanding of the importance of the extensive central mangrove swamp, the largest area of inland mangrove in the Caribbean, to the general wetlands of Grand Cayman as a whole.
b) Monospecific *Conocarpus* woodland and thicket form swamps on Bluff limestone in the eastern part of Grand Cayman and Little Cayman. Other plants present include *Tillandsia* sp and *Rhabdadenia biflora.*
c) *Typha* swamps are dependent on rainfall and evapotranspiration, and all dry out seasonally. They are decreasing in extent on Grand Cayman and occur minimally on Cayman Brac and Little Cayman. The dominant plants are *Typha domingensis, Sagittaria leucifolia, Cladium jamaicensis, Acrostichum aureum* and *Rhabdadenia biflora.*
d) Sedge swamps occur around seasonally flooded ponds on agricultural land in Grand Cayman; the predominant vegetation is *Eleocharis* sp.
e) Seasonal pools on flooded grassland provide temporary wetland habitat for some waterfowl.
f) The coastal systems include coral rubble, sandy beaches, steep bluffs and ironshore, with the vegetation dependent on the degree of exposure to wind and waves. The strand scrub and littoral hedge is a band of coastal woodland 10-50m from the sea and dominated by *Coccoloba uvifera.*

Institutional Base for Wetland Conservation and Research

The department of Government concerned with conservation policy is the Portfolio of Agriculture, Lands and Natural Resources; it recommends to Cabinet conservation measures considered necessary throughout the Cayman Islands. The only organization involved in wetland research is the Mosquito Research and Control Unit, a department of Agriculture, Lands and Natural Resources in the Government of the Cayman Islands. Both organizations are based in George Town, Grand Cayman. There are at present no non-governmental conservation organizations concerned with wetlands and waterfowl.

Progress in Wetland Conservation and Research

The legislative measures taken to date to conserve wetlands in the Cayman Islands and the areas which have been declared Animal Sanctuaries are as follows:

a) The Animals Law (Law 8 of 1976) Part VII, Section 70; establishing two sanctuaries, Meagre Bay Pond (38 ha) and Colliers Bay Pond (32 ha) on Grand Cayman.
b) The Animals (Sanctuaries) Regulations, 1980; establishing a sanctuary of 24 ha on Cayman Brac, including the two Westerly Ponds and Salt Water Pond.
c) The Animals (Sanctuaries) Regulations, 1982; establishing a sanctuary of 72 ha on Little Cayman, including Booby Pond and an area to the north of the fringing mangroves called The Rookery.

The Development Plan of 1977 concerns Grand Cayman only; it was modified slightly in 1980, and adopted by the Cayman Islands Government in 1981. The Plan calls for the incorporation of 97% of Grand Cayman's wetlands into urban and agricultural schemes, a process that will take several years. By 1980 all the wetlands west of 81°10'W, with the exception of Meagre Bay Pond (Animal Sanctuary), had been returned from the possession of the Crown to private ownership to implement the Development Plan. However, a fringe of mangroves is to be retained around parts of North Sound to act as a hurricane barrier.

Cayman Islands

The Oxford University Expedition to the Cayman Islands in 1938 was the first natural history survey of the islands and included papers on wetlands, geology, the flora and the fauna. Since 1965, all research on wetlands has been coordinated with or carried out by the Mosquito Research and Control Unit. Research at the MRCU dates back to 1965 and has been dominated by work related to the control of brackish floodwater mosquitos. In order to provide the detailed ecological background information needed for an integrated mosquito control programme, this work has included a diversity of wetlands research. In addition, resident and visiting scientists at MRCU's Natural Resources Laboratory have generated a body of work less related to mosquito control interests.

Recent publications of note include mangrove species zonation maps for the islands, and studies on the flight behaviour of the dominant pest mosquito *Aedes taeniorhynchus*, the ecology of mangrove fishes, and mangrove swamp morphology and development in Grand Cayman. Unpublished work of interest includes long term records of tidal and meteorological data used in the routine prediction of mosquito emergence, and studies on water movements in mangroves and autogeny in *Aedes taeniorhynchus*. From 1964 to 1972, D.W. Johnston carried out a study of the avifauna and ecology of the Cayman Islands (Johnston, 1975 & Johnston *et al*, 1971), and A.W. Diamond published on the birds of Little Cayman in 1975 (Diamond, 1975a & 1975b). Other published work is mostly in the form of check lists, and only mentions waterfowl as part of the total avifauna.

No details of a waterfowl banding programme are known. Some authors mention banding mist-netted birds but there has been no correlation with Cayman Islands Government or any follow-up programme. The only present avifaunal research is by the author, and involves the preparation of a check-list for the three islands; a study of the size of the breeding population of *Dendrocygna arborea*; observations on the colony of *Fregata magnificens* and Sulidae on Little Cayman; and a study of the population dynamics of *Egretta thula* and *Egretta tricolor*. However, plans exist to undertake a programme of banding nesting Ardeidae, Sulidae and *Fregata magnificens* in Little Cayman in 1985.

Major Threats to Wetlands and Waterfowl

The pace of implementation of the Development Plan for Grand Cayman is increasing, and there are extensive development projects planned for 1985-1986 in the western part of the island. These include a golf course and road building, hotel, marina, condominium and housing developments. All will involve the wholescale destruction of wetlands. The ultimate removal of 97% of the island's wetland habitat would mean a dramatic decline in wildlife populations, and every effort should be made to persuade the Cayman Islands Government to introduce further conservation measures before it is too late.

Waterfowl populations are threatened not only by the loss of habitat but also by a lack of control on hunting, the extensive game list including several rare species, and by the large number of feral dogs and cats which roam the islands. *Dendrocygna arborea* is especially at risk, and continued illegal shooting of birds is now significant in the small population which remains.

In Cayman Brac, there is a proposal that the Westerly Ponds should be filled in as they are considered a hazard to aircraft, and the mangroves between the Westerly Ponds and Salt Water Pond are already being cleared for runway extension. The marshes are privately owned and part of this wetland is used as a public rubbish dump. The total waterfowl population of Cayman Brac is at risk if the Westerly Ponds are filled as there is insufficient alternative wetland habitat to support viable populations. At present, the island supports a thriving and surprisingly rich waterfowl population which finds refuge in an Animal Sanctuary amid the activity of the airport and tourist hotels.

In Little Cayman, hunting poses a serious threat to waterfowl; strict control or cessation would allow the now reduced populations of ducks to increase in numbers and would give the endangered West Indian Tree Duck *Dendrocygna arborea* protection at breeding sites, thus ensuring the survival of the Cayman Islands' only breeding duck. The heronry with five breeding species of Ardeidae, at the back of the Rookery, has not been included in the Sanctuary; it is privately owned and there is a possibility that the area will be affected by road and airport runway development.

Acknowledgements

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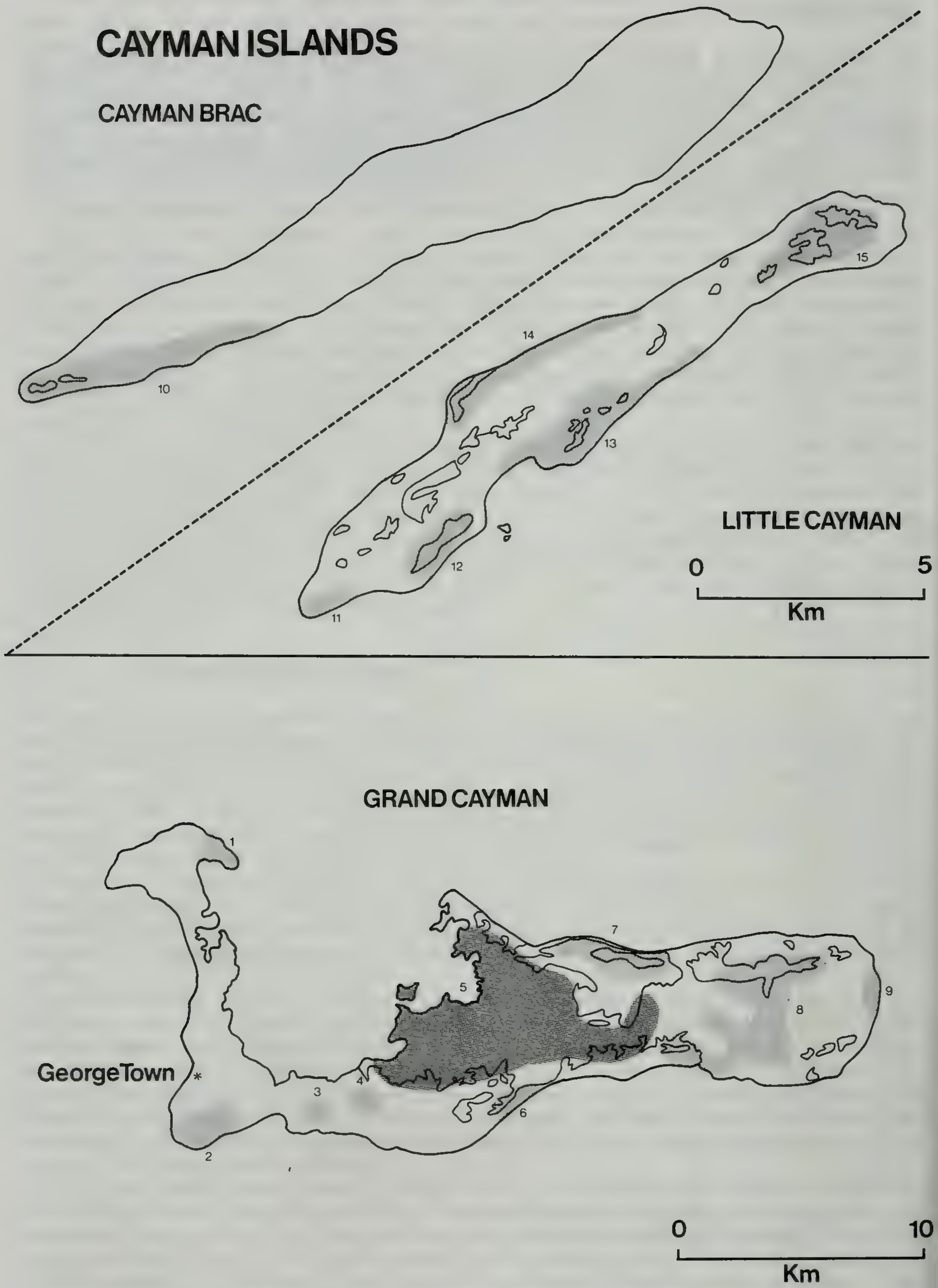

CAYMAN ISLANDS
CAYMAN BRAC
10
14
15
13
12
11
LITTLE CAYMAN
0
5
Km
GRAND CAYMAN
1
7
5
9
8
GeorgeTown
*
3
4
6
2
0
10
Km

WETLANDS

Site descriptions based on data sheets provided by Patricia Bradley, Department of Agriculture, Lands and Natural Resources.

Barkers Wetland (1)

Location: 19°23'N, 81°23'W; on the northeast point of West Bay Peninsula, Grand Cayman.
Area: 200 ha.
Altitude: 0.5-0.7m.
Province and type: 8.39.13; 05, 07 & 08.
Site description: A mixed mangrove swamp on a promontory, with several small brackish lagoons behind a 2m beach ridge, a sandy beach to the north, and the mangrove fringe of North Sound to the south. The three main ponds are Sea Pond (3.7 ha), Vulgunnes Pond (5.4 ha) and Palmetto Pond (6.0 ha). Sea Pond is connected to the sea by a fissure in the underlying rock and shows delayed tidal influence; the other two ponds are connected by canals and are also affected by the tides. Salinities range from 33 to 49 p.p.t.; and water levels fluctuate seasonally from a high in December to a low in May, when large areas are dry.
Principal vegetation: Mangrove swamps with *Avicennia germinans, Laguncularia racemosa, Conocarpus erectus* and *Rhizophora mangle*; saline marshes and flats with *Sporobolus virginicus, Sesuvium portulacastrum, Salicornia bigleovia, Batis maritima* and *Philoxerus vermicularia*; beach communities with *Thrinax radiata, Hymenocallis* sp, *Terminalia catappa, Caesalpinia* sp, *Cenchus* sp, *Coccoloba uvifera, Stachytarpheta jamaicensis, Ipomoea macrantha, I. pescaprae, Paspalum* sp, *Spartina patens* and *Thespesia populnea.*
Land tenure: Privately owned.
Protection: None.
Land use: Hunting, fishing, recreation and livestock grazing.
Waterfowl: An important area for a wide variety of breeding, passage and wintering waterfowl. Breeding species include *Podilymbus podiceps, Butorides virescens, Anas platyrhynchos* (introduced), *Gallinula chloropus, Catoptrophorus semipalmatus, Himantopus himantopus* and *Sterna albifrons*. Many Ardeidae breeding elsewhere on the island feed and roost at Barkers Wetland; counts have included up to *15 Nyctanassa violacea, 65 Bubulcus ibis, 20 Egretta caerulea, 138 E. tricolor* and *350 E. thula.* Passage and wintering species include *Ardea herodias, Anas discors, Fulica americana, Pluvialis squatarola, Charadrius semipalmatus, Tringa melanoleuca, T. flavipes, Arenaria interpres, Limnodromus griseus, Calidris pusilla, C. minutilla* and *Chlidonias nigra.* The area is also interesting for the number of uncommon migrants which have occurred.
Other fauna: The White-crowned Pigeon *Columba leucocephala* breeds in the mangroves. Fishes include *Megalops atlantica, Gambusia caymanensis* and *Limia caymanensis*; Decapoda include *Cardisoma sp, Pachygraspus transversus, Uca sp, Goniopsis crientata* and *Mithrax sp.*
Threats: Coastal lands are being cleared for housing development and road building; ponds are being filled in with material dredged from North Sound; some areas are being used for the dumping of rubbish; and there is uncontrolled hunting of waterfowl. Land around Palmetto Pond has been purchased and plans have been drawn up for a condominium/marina complex which would destroy the pond.
Research and conservation: The fauna and flora of the area have been well documented. The destruction of Palmetto Pond might be avoided if the private developers could be persuaded to retain the pond as a natural feature within their complex.
Source: Patricia Bradley.
Criteria for inclusion: 2b & 3a.

South Sound Swamp and Half Way Pond (2)

Location: 19°17'N, 81°22'W; 4 km southeast of Hog Sty Bay, Grand Cayman.
Area: 309 ha.
Altitude: 0-0.5m.

Province and type: 8.39.13; 05, 07 & 08.
Site description: A large mangrove swamp, underlain by mangrove peat and Bluff limestone, behind a beach ridge; the adjacent shore of South Sound; and a brackish *Typha* swamp of 7.2 ha at Half Way Pond to the north (the only significant *Typha* swamp remaining in Grand Cayman). Water levels fluctuate according to rainfall and evaporation, and the *Typha* swamp dries out in summer.
Principal vegetation: Mangrove forest with *Avicennia germinans, Laguncularia racemosa, Conocarpus erectus, Rhizophora mangle, Acrostichum aureum, Ipomoea macantha, Rhabdadenia biflora, Batis maritima, Philoxerus* sp, *Tillandsia* sp, *Cassytha* sp, *Heliotropium* sp and *Cynodon* sp; brackish swamp with *Typha domingensis, Sagittaria lancifolia, Ruppia maritima, Vigna luteola, Cladium jamaicensis, Blechum serrulatum* and *Acrostichum aureum*; and beach communities similar to site 1.
Land tenure: Privately owned.
Protection: None.
Land use: Housing development and agriculture around the wetland. The area provides a park-like habitat close to George Town with extensive traffic-free recreation areas and a wetland habitat for study by five schools along the boundary.
Waterfowl: An important area for a variety of breeding, passage and wintering waterfowl, with almost the same species as Barkers Wetland (site 1). Additional species in the *Typha* swamp include *Porphyrula martinica* (breeding), and *Ixobrychus exilis* (winter visitor).
Other fauna: The endemic grackle *Quiscalus niger caymanensis* breeds; and *Pandion haliaetus, Falco peregrinus, F. columbarius* and *Ceryle alcyon* occur in winter.
Threats: Clearing and filling for development are already making serious inroads into the mangrove swamp; the main lagoon was filled in March 1984, two large areas in the centre of the swamp were cleared for building in late 1984, and the *Typha* swamp is now threatened. The Development Plan schedules use of the area for light industry and housing, and the entire swamp is likely to be filled within three to four years.
References: Woodroffe (1979).
Source: Patricia Bradley.
Criteria for inclusion: 2b & 3a.

Prospect Marsh (3)

Location: 19°17'N, 81°19'W; 11 km east of Hog Sty Bay, Grand Cayman.
Area: 38 ha.
Altitude: 1m.
Province and type: 8.39.13; 07 & 08.
Site description: Two permanently flooded marl pits, up to 3m deep, with fringing mangrove swamps, and cleared marshy land subject to seasonal flooding with brackish water (salinity 17 p.p.t.). The seasonal marshes are dry for about 30% of the year.
Principal vegetation: Mangrove forest with *Avicennia germinans, Conocarpus erectus* and *Rhizophora mangle*; seasonally flooded marshes with *Rhabdadenia biflora, Typha domingensis, Cladium jamaicensis* and *Sesuvium portulacastrum.*
Land tenure: Privately owned.
Protection: None.
Land use: Hunting and dumping of rubbish. The marsh area was originally cleared for the construction of a golf course.
Waterfowl: An important area for a variety of breeding, passage and wintering waterfowl, with almost the same species as Barkers Wetland (site 1). Counts of breeding birds have included up to 90 *Egretta tricolor*, 500 *E. thula* and 50 *Himantopus himantopus.*
Other fauna: *Pandion haliaetus, Falco columbarius* and *Ceryle alcyon* occur in winter. The area has a very rich bird fauna, and many of the subspecies endemic to the Cayman Islands occur, including *Amazona leucocephala caymanensis.* Fishes include *Megalops atlantica* and Decapoda include *Cardisoma* sp.
Threats: The principal threat at present is excessive hunting, but the area is likely to be developed as soon as an investor can be found.
Source: Patricia Bradley.
Criteria for inclusion: 2a & 2b.

Westerly Freshwater Wetlands (4)

Location: 19°16'N, 81°18'W; 1 km north, east and west of Savannah, Grand Cayman.
Area: Lower Valley Wetland 0.8 ha; Savannah Wetland 1.0 ha; Newlands Wetland 1.4 ha.
Altitude: 3-5m.
Province and type: 8.39.13; 07, 08 & 13.
Site description: A complex of small, permanent and seasonal fresh to brackish ponds, marshes and mangrove swamps in three small wetland areas lying over a freshwater levee in 475 ha of agricultural land. Salinities range from fresh to 10 p.p.t., and water levels fluctuate with seasonal rainfall and evapotranspiration. Much of the marsh area dries out in summer.
Principal vegetation: Originally, the predominant vegetation was a monospecific thicket of *Conocarpus erectus*, but the great majority of this has been cleared for livestock grazing and urban development. In addition to *C. erectus*, the predominant vegetation now includes *Laguncularia racemosa, Acrostichum aureum, Typha domingensis, Panicum purpurascens, Eleocharis mutata, Sesuvium portulacastrum* and *Cladium jamaicensis.*
Land tenure: Privately owned.
Protection: None.
Land use: Hunting and livestock grazing.
Waterfowl: An important area for a wide variety of breeding waterfowl, with almost the same species as Barkers Wetland (site 1), but also large populations of *Dendrocygna arborea* (counts of up to 32 birds at Lower Valley Wetland and up to 30 at Newlands Wetland) and *Porphyrula martinica* (up to 25 at Newlands). Passage and wintering birds include *Ardea herodias, Anas discors, Fulica americana* and a variety of shorebirds, notably *Gallinago gallinago.*
Other fauna: *Falco columbarius* and *Ceryle alcyon* occur in winter.
Threats: There is uncontrolled hunting in the area, and housing development is gradually taking over the surrounding agricultural land.
Research and conservation: The owner of Savannah Wetland has agreed to ban hunting on his land if the Government will provide the "no hunting" signs. The owner of Lower Valley Wetland might similarly be persuaded to ban hunting.
Source: Patricia Bradley.
Criteria for inclusion: 2a, 2b & 3a.

Central Mangrove Swamp and Booby Cay (5)

Location: 19°20'N, 81°16'W; east side of North Sound, Grand Cayman.
Area: 4,677 ha (including Booby Cay 57 ha).
Altitude: 0-0.5m.
Province and type: 8.39.13; 03, 07 & 08.
Site description: An extensive mixed mangrove forest enclosing several hundred small saline ponds which flood in the wet season; and a mangrove covered cay lying offshore in a marine sound. The water level in the mangroves is dependent on tidal inundation along the border of North Sound, and on a combination of rainfall, evapotranspiration and tides in the interior. Salinities at ponds in the interior range from 34-46 p.p.t.
Principal vegetation: Mangrove swamps with *Avicennia germinans, Laguncularia racemosa, Conocarpus erectus* and *Rhizophora mangle*; *Tillandsia* sp, *Rhabdadenia biflora, Batis maritima* and *Acrostichum aureum.*
Land tenure: The mangrove swamp is privately owned except for a 150m fringe around North Sound which, like Booby Cay, is owned by the Crown (Cayman Islands Government).
Protection: The 150m wide fringe of mangroves around North Sound and Booby Cay are protected from development.
Land use: Hunting along the perimeter of the swamp; harvesting of nestlings of Ardeidae at the Booby Cay colony.
Waterfowl: Booby Cay supports an important breeding colony of Ardeidae with 250 pairs of *Egretta caerulea*, 70 pairs of *E. tricolor* and over 1,000 pairs of *E. thula* in the 1984/85 season. Up to 150 *Bubulcus ibis* have been observed, but none were found breeding in 1984/85. The Central Mangrove Swamp constitutes a major feeding area for the birds nesting on Booby Cay, and a breeding area for other species such as *Butorides virescens, Dendrocygna arborea* (54 birds recorded in two flocks), and *Gallinula chloropus. Anas discors* and a variety

of shorebirds occur on migration and in winter.

Other fauna: Other birds frequenting the mangroves include *Columba leucocephala, Amazona leucocephala caymanensis, Quiscalus niger caymanensis, Dendroica petechia* and wintering *Seiurus noveboracensis.*

Threats: Mangroves have been cleared and development has begun along the south and east edges of the swamp, and is to continue around the perimeter. There is uncontrolled hunting in the swamp.

Research and conservation: This large area of inland mangrove is unique in the Caribbean, and clearly merits further study. New Marine Parks Regulations propose to create a "Zone of Regeneration" to include a 300m eastern coastal mangrove belt, Booby Cay, and the waters to the north, east and south. If declared law, hunting and fishing would be banned and boat traffic would be restricted, thus protecting the heron colony. It is possible that further areas of mangrove could be purchased by the Government at a later date.

References: Woodroffe (1981).

Source: Patricia Bradley.

Criteria for inclusion: 2a, 2b & 3b.

Meagre Bay Pond and Pease Bay Pond (6)

Location: 19°17'N, 81°13'W; at Pease Bay, Grand Cayman.

Area: Meagre Bay Pond 38.4 ha; Pease Bay Pond 8.2 ha.

Altitude: 0.5m.

Province and type: 8.39.13; 07 & 08.

Site description: Two shallow hypersaline lagoons with mangrove swamps, and rocky outcrops to the east and north. The ponds are dependent on delayed tidal influence, rainfall and evapotranspiration; water levels fluctuate considerably, and large areas dry out in the dry season. Salinities range from 35-38 p.p.t.

Principal vegetation: Mangrove swamps with *Avicennia germinans* and *Conocarpus erectus*; also *Batis maritima, Philoxeris vermicularis, Sesuvium portulacastrum* and *Ruppia maritima.*

Land tenure: Meagre Bay Pond is owned by the Crown (Cayman Islands Government); Pease Bay Pond is privately owned.

Protection: Meagre Bay Pond is protected under the Animals Sanctuaries Law; Pease Bay Pond is unprotected.

Land use: Illegal hunting at Meagre Bay Pond; hunting, recreation and housing development along the shores of Pease Bay Pond.

Waterfowl: An important breeding, passage and wintering area for a wide variety of waterfowl, with almost the same species as Barkers Wetland (site 1). Counts at Meagre Bay Pond have included up to *170 Podilymbus podiceps, 96 Egretta tricolor, 610 E. thula, 16 E. alba, 60 Tringa melanoleuca, 150 Himantopus himantopus and 100 Sterna albifrons. Dendrocygna arborea* is a fairly common resident; up to 36 have been observed at Meagre Bay Pond, and birds occasionally feed at night at Pease Bay Pond. Wintering Anatidae include up to 95 *Anas discors* and small numbers of *A. americana, A. clypeata* and *Aythya affinis.*

Other fauna: *Pandion haliaetus, Falco peregrinus, F. columbarius* and *Ceryle alcyon* occur in winter. The mangrove swamp to the north of the ponds is a major breeding site for *Amazona leucocephala caymanensis.*

Threats: There are pressures from increased urbanization around Pease Bay Pond, and hunting is uncontrolled.

Research and conservation: A recent proposal to extend the Meagre Bay Sanctuary has been turned down. An appeal could be made to the owners of Pease Bay Pond to protect it and declare it a "no hunting" zone.

Source: Patricia Bradley.

Criteria for inclusion: 2a & 3a.

Conocarpus Swamps and Frank Sound Wetland (7)

Location: 19°19'N, 81°10'W; in the interior of eastern Grand Cayman, extending to the southeast coast.
Area: 1,071 ha. (North Swamp 443 ha, Central Swamp 148 ha, South Swamp 348 ha, Frank Sound 132 ha).
Altitude: 0.6-6.0m.
Province and type: 8.39.13; 05, 07 & 08.
Site description: Three extensive monospecific thickets of *Conocarpus erectus* in an interior basin of the island. The swamps enclose a number of slightly brackish seasonal ponds and marshes, and there is some mixed mangrove swamp in the southern section. The nearby Frank Sound wetland is a mixed mangrove swamp behind a 2m beach ridge, enclosing a sedge marsh and with seasonally flooded brackish marshes and a *Conocarpus* swamp to the north. Water levels are dependent on rainfall and evapotranspiration; the *Conocarpus* swamps dry out completely in the dry season, but there is some tidal influence in the southern part of Frank Sound wetland.
Principal vegetation: Thickets of *Conocarpus erectus*; mixed mangrove swamps with *Avicennia germinans, Laguncularia racemosa, C. erectus* and *Rhizophora mangle*; also *Rhabdadenia biflora, Tillandsia sp, Panicum purpurascens, Cladium jamaicensis, Eleocharis mutata* and *Cyperus sp.*
Land tenure: The North and South Swamps are owned by the Crown (Cayman Islands Government); Frank Sound wetland and the Central Swamp are privately owned.
Protection: None.
Land use: Hunting and livestock grazing. A sealed road bisects the South Swamp.
Waterfowl: The North and South Swamps are very difficult of access and poorly know; large numbers of Ardeidae have been observed feeding in the North Swamp, and it is possible that both swamps are major wintering areas for waterfowl. The Central Swamp was a traditional breeding site for *Dendrocygna arborea* but recent clearing has resulted in the disappearance of the species from that area. A variety of breeding, passage and wintering birds have been recorded at Frank Sound wetland, including up to 12 *D. arborea* which breed there.
Other fauna: *Falco peregrinus, F. columbarius* and *Ceryle alcyon* have been recorded in winter. The swamps are a major breeding area for *Leptoptila jamaicensis collaris, Amazona leucocephala caymanensis* (up to 130 observed in the Central Swamp), and *Dendroica petechia.*
Threats: There is uncontrolled hunting; and the mangroves are being cleared for development around the Central and South Swamps, and along the northern and southern boundaries of Frank Sound wetland. There are no threats at present to the large North Swamp.
Research and conservation: The undisturbed North Swamp (443 ha) and the South Swamp (348 ha) are both clearly worthy of protection.
Source: Patricia Bradley.
Criteria for inclusion: 2a & 3a.

Malportas Pond, Rock Pond and Point Pond (8)

Location: 19°21'N, 81°12'W; near North Side Town, Grand Cayman.
Area: 414 ha (Malportas Pond 52 ha, Point Pond 2.4 ha).
Altitude: 0.5-1.0m.
Province and type: 8.39.13; 07 & 08.
Site description: A shallow saline lagoon (Malportas Pond) with fringing mangroves and five mangrove covered islets; a small shallow brackish pond (Point Pond) with mixed woodland fringe; and a *Conocarpus* swamp (Rock Pond) to the west. The three wetlands lie between limestone ridges, and there is a 6m high beach ridge to the north of Point Pond. The lagoons are permanent, but water levels fluctuate greatly according to rainfall and evapotranspiration, and Malportas Pond is 90% dry by April. There is some tidal influence at Malportas Pond during the wet season.
Principal vegetation: Mangrove swamps with *Avicennia germinans* and *Conocarpus erectus*; also *Sesuvium portulacastrum, Paspalum sp, Tillandsia sp, Batis maritima, Spartina patens, Ruppia maritima, Canvalia sp, Ipomoea macrantha, Hymenocallis latifolia, Terminolia catappa, Cynodon sp, Caesalpinia sp, Philoxerus vermicularia* and *Coccoloba uvifera.*

Land tenure: Owned by the Crown (Cayman Islands Government).
Protection: Recently declared an Animal Sanctuary.
Land use: Hunting. A road passes close to the ponds, and there are houses on the south and west borders of Point Pond.
Waterfowl: An important area for breeding, passage and wintering waterfowl, with almost the same species as Barkers Wetland (site 1). Small numbers of *Dendrocygna arborea* have been recorded at both ponds. The area is particularly important for breeding *Sterna albifrons*, and wintering *Anas discors* and *Gallinago gallinago.*
Other fauna: *Pandion haliaetus, Falco columbarius* and *Ceryle alcyon* have been recorded in winter.
Threats: There is increased urban development, particularly in the west, and recent agriculture and housing projects have extended to within 300m of Malportas Pond.
Source: Patricia Bradley.
Criteria for inclusion: 2a & 3a.

Colliers Bay Pond (9)

Location: 19°20'N, 81°05'W; at the eastern tip of Grand Cayman.
Area: 32.5 ha.
Altitude: 0-1m.
Province and type: 8.39.13; 05, 07 & 08.
Site description: A permanent shallow saline lagoon with a wide fringe of mangroves in the west, one mangrove covered islet, and a beach ridge to the east. The water level is dependent on rainfall and evapotranspiration; the depth reaches a maximum of 70 cm in the wet season (September to January) and is at its lowest in May. The salinity is 35 p.p.t.
Principal vegetation: Mangrove swamps with *Avicennia germinans* and *Conocarpus erectus*; also *Sesuvium portulacastrum, Batis maritima, Ipomoea macularia, I. pescaprae, Cynodon sp, Caesalpinia sp, Bidens sp, Sporobolus virginicus* and beach communities.
Land tenure: Owned by the Crown (Cayman Islands Government).
Protection: An Animal Sanctuary.
Land use: Bird-watching. A main road crosses the northeast end of the pond, and there is a hotel nearby.
Waterfowl: An important area for breeding, passage and wintering waterfowl, with almost the same species as Barkers Wetland (site 1). The area is particularly interesting for the variety of uncommon transients which have occurred.
Other fauna: *Falco columbarius* and *Ceryle alcyon* occur in winter.
Threats: There is some illegal hunting.
Source: Patricia Bradley.
Criteria for inclusion: 3a.

Westerly Ponds, Salt Water Pond and The Marshes (10)

Location: 19°41'N, 79°51'-79°54'W; near Gerrard Smith Airport, on the southwest coast of Cayman Brac.
Area: 43.8 ha (Westerly Ponds 16.8 ha; Salt Water Pond 7.8 ha; The Marshes 19.2 ha).
Altitude: 0m.
Province and type: 8.39.13; 05, 07 & 08.
Site description: Three permanent saline lagoons (the two Westerly Ponds and Salt Water Pond), 0.5-1.0m deep, with mangrove fringes and three mangrove covered cays, separated from the sea by a sand ridge; and an area of mangroves with seasonal pools and muddy areas on an exposed ironshore bedrock platform parallel to the coast (The Marshes). The lagoons are subject to tidal influence. Salinities vary from 42-69 p.p.t., and there are wide fluctuations in

water level, the Westerly Ponds becoming 60% dry by May, and The Marshes drying out completely during the summer.

Principal vegetation: Mangrove swamps with *Laguncularia racemosa, Conocarpus erectus* (particularly in The Marshes) and *Rhizophora mangle*; also *Sporobolus virginicus, Sesuvium portulacastrum, Coccoloba uvifera, Cladium jamaicensis, Caesalpinia crista, Hymenocallus sp, Ipomoea macantha, I. pescaprae, Cassaytha sp, Hippomane mancinella* and *Cenchus sp.*

Land tenure: Westerly Ponds and Salt Water Pond are owned by the Crown (Cayman Islands Government); The Marshes are privately owned.

Protection: Westerly Ponds and Salt Water Pond were declared an Animal Sanctuary in 1980. The Marshes are unprotected.

Land use: Dumping of asphalt drums (Westerly Ponds) and rubbish (The Marshes); quarrying for marl at The Marshes. There is an airport runway on the northern boundary of Westerly Ponds, two hotels to the south, and a gravel crushing plant between the two lagoons.

Waterfowl: A very important group of wetlands for a wide variety of breeding, passage and wintering waterfowl. Breeding species include *Podilymbus podiceps, Nyctanassa violacea, Butorides virescens, Gallinula chloropus, Porphyrula martinica, Himantopus himantopus* and *Sterna albifrons.* Ardeidae breeding on Little Cayman use the area for feeding; small numbers of *Egretta caerulea, E. tricolor* and *E. thula* are present year round, and up to 250*E. tricolor and 500 E. thula* have been recorded during the spring migration season. Common passage migrants and winter visitors include *Anas discors* (up to 100), *Fulica americana*, many Nearctic shorebirds and *Chlidonias nigra. Dendrocygna arborea* breeding on Little Cayman are reported to fly over to Westerly Ponds to feed at night, returning to Little Cayman before dawn.

Other fauna: The area supports a rich resident avifauna, and *Falco columbarius, Ceryle alcyon* and *Seiurus noveboracensis* occur in winter.

Threats: The dumping of rubbish and asphalt drums is gradually reducing the extent of the wetlands, and causing a serious pollution problem at Westerly Ponds. The flights of Ardeidae and *Anas discors* at Westerly Ponds are regarded as a hazard to aircraft and proposals have been made to fill in the lagoons completely to get rid of the birds. Much of the mangrove swamp between Westerly Ponds and Salt Water Pond has already been filled in for an airport runway extension.

Research and conservation: The three wetlands together provide secure breeding, feeding and roosting habitat for a wide range of bird species, and constitute the only major wetland site on Cayman Brac. They lie close to three tourist hotels, and are thus of great educational and recreational value. Steps should be taken to purchase The Marshes as a Sanctuary, particularly if the decision is taken to fill in the Westerly Ponds.

References: Johnston *et al* (1971); Olson *et al* (1981).

Source: Patricia Bradley.

Criteria for inclusion: 2b & 3a.

Westerly Wetland and Preston Bay Ponds (11)

Location: 19°39'N, 80°06'W; 1 km west of the airstrip, Little Cayman.

Area: 8.5 ha.

Altitude: 3m.

Province and type: 8.39.13; 07 & 08.

Site description: A chain of small brackish lagoons with a mangrove fringe, and seasonal rainwater pools; on exposed ironshore behind a coral rubble beach. Salinities range from 20-40 p.p.t., and water levels fluctuate according to rainfall and evaporation.

Principal vegetation: The mangroves *Laguncularia racemosa* and *Conocarpus erectus*, with *Acrostichum aureum, Ruppia maritima, Coccoloba uvifera, Thespesia populnea, Sesuvium portulacastrum, Ambrosia hispida, Cordia sequestria, Sporobolus virginicus, Borrichia arborescens* and *Salicornia bigelovia.*

Land tenure: Privately owned.

Protection: None.

Land use: The principal area on the island for the collection of crabs *Cardisoma* sp; alsoduck hunting.

Waterfowl: Breeding species include *Podilymbus podiceps, Butorides virescens, Gallinula chloropus, Catoptrophorus semipalmatus* and *Himantopus himantopus. Bubulcus ibis, Egretta caerulea, E. tricolor* and *E. thula* from the breeding colony near Booby Pond (site 12) use the area as a feeding site, and *Anas discors* and many Nearctic shorebirds occur on passage and in winter.
Other fauna: *Pandion haliaetus, Falco columbarius* and *Alcyon ceryle* occur in winter.
Threats: Road building schemes and a proposal for condominium and villa developments on the coast to the south of the wetland pose potential threats to the area.
References: Stoddart (1980b).
Source: Patricia Bradley.
Criteria for inclusion: 3a.

Booby Pond and nearby Heronry (12)

Location: 19°40'N, 80°04'W; east of the airstrip, Little Cayman.
Area: 50 ha, including 6 ha of woodland.
Altitude: 0-3m.
Province and type: 8.39.13; 05, 07 & 08.
Site description: A largely seasonal hypersaline lagoon, up to 70 cm deep, with extensive mangrove fringe, bounded to the south by a coastal sand beach; and a mixed woodland on platform rock to the north of the mangrove fringe. The salinity is 69 p.p.t.; the water level fluctuates widely according to rainfall, evapotranspiration and the tides, and the lagoon dries out in summer.
Principal vegetation: Mangrove swamps with *Avicennia germinans, Laguncularia racemosa* and *Rhizophora mangle*; *Thespesia populnea* and *Cordia* sp; and mixed woodland with *Bursera simaruba, Canella winterana, Guipera discolor, Coccothrinax jamaicensis, Ficus aurea, Myrcianthes fragrans, Cephalocerus swartzii* and *Plumeria obtusa.*
Land tenure: Booby Pond is owned by the Crown (Cayman Islands Government); the adjacent beach and the heronry are privately owned.
Protection: Booby Pond and its mangrove fringe are included in an Animal Sanctuary in which hunting and the taking of eggs are prohibited. Other areas are unprotected.
Land use: Sport fishing, hunting, bird-watching and tourist recreation along the beach. Booby Pond is used as a public dump, and eggs (of Sulidae) and nestlings (of Ardeidae) are collected for food.
Waterfowl: Booby Pond is an important feeding area for resident and migratory Ardeidae, and passage and wintering Nearctic shorebirds. Peak counts have included up to *95 Egretta tricolor, 550 E. thula, 200 Tringa melanoleuca, 50 T. flavipes and 50 Limnodromus griseus. Breeding species include Nyctanassa violacea* and *Sterna albifrons* (up to 83 birds recorded). *Dendrocygna arborea* is reported to visit the lagoon at night to feed. The woodland supports a breeding colony of Ardeidae; counts of breeding adults have included *28 Bubulcus ibis, 16 Egretta caerulea, 85 E. tricolor and 500 E. thula.*
Other fauna: *Falco columbarius* and *Ceryle alcyon* occur in winter. There are large breeding colonies of *Sula sula* (up to 7,000 birds) and *Fregata magnificens* (up to 350 birds), and the Cayman Island endemics *Elaenia martinica caymanensis* and *Quiscalus niger bangsi* breed.
Threats: Asphalt drums and rubbish are being dumped into the lagoon, and there is illegal taking of eggs of Sulidae and nestlings of Ardeidae.
Research and conservation: Studies have been conducted on the breeding sea-birds. Because of its easy access and close proximity to major tourist facilities, the wetland has great value for nature tourism. The resiting of the public rubbish dump away from the Sanctuary has been approved. The woodland containing the heronry should be included in the Animal Sanctuary, either by purchase by the Government or as a private sanctuary declared by the owners.
References: Beard (1955); Diamond (1975a & 1975b); Stoddart (1980b).
Source: Patricia Bradley.
Criteria for inclusion: 2b, 2c & 3a.

Tarpon Lake and Wearis Bay Wetlands (13)

Location: 19°41'N, 80°02'W; 3.5 km east of the airstrip, Little Cayman.
Area: 236 ha.
Altitude: 0.5-1.0m.
Province and type: 8.39.13; 07 & 08.
Site description: An extensive coastal mangrove forest behind a beach ridge, with a permanent saline lagoon (15.6 ha), up to 1.5m deep, and many seasonally flooded ponds. The salinity of the lagoon is 24.5 p.p.t., and the water level fluctuates according to rainfall and evapotranspiration.
Principal vegetation: Mangrove swamps with *Avicennia germinans, Laguncularia racemosa, Conocarpus erectus, Rhizophora mangle* and *Rhabdadenia biflora.*
Land tenure: Owned by the Crown (Cayman Islands Government).
Protection: None. Hotel guides taking tourists fishing have banned the use of live bait.
Land use: Sport fishing for Tarpon, waterfowl hunting and tourist recreation. Access to the lagoon is on a board walk through mangrove forest.
Waterfowl: Important for breeding and wintering waterfowl of a wide variety of species. The area is particularly important for breeding *Dendrocygna arborea*; up to 32 birds have been observed in a single flock. Other breeding species include *Nyctanassa violacea, Butorides virescens, Gallinula chloropus* and *Himantopus himantopus* (up to 120 birds). Wintering birds include *Ardea herodias, Anas discors, Aix sponsa, Aythya affinis, Fulica americana* and small numbers of shorebirds.
Other fauna: *Quiscalus niger bangsi* and *Dendroica petechia* breed. The Tarpon *Megalops atlantica* is common, and the sea turtle *Chelonia mydas* has been introduced.
Threats: There is uncontrolled hunting, including illegal hunting of the protected *Dendrocygna arborea.*
Research and conservation: The lagoon should be included in an Animal Sanctuary which would necessitate a change in the Animals Law (1976) to allow fishing within a sanctuary.
References: Stoddart (1980b); Woodroffe (1980).
Source: Patricia Bradley.
Criteria for inclusion: 2a & 3a.

North Mangrove Swamp (14)

Location: 19°42'N, 80°03'W; 8 km northeast of the airstrip, Little Cayman.
Area: 103 ha.
Altitude: 0m.
Province and type: 8.39.13; 07 & 08.
Site description: A long narrow coastal mangrove swamp with several saline lagoons, up to 1m deep, and many seasonal ponds, bounded to the south by a low limestone ridge. Water levels are dependent on rainfall, evapotranspiration and the tides, and the ponds dry out completely during the dry season.
Principal vegetation: Monospecific mangrove swamps of *Rhizophora mangle.*
Land tenure: Owned by the Crown (Cayman Islands Government).
Protection: None.
Land use: Waterfowl hunting.
Waterfowl: An important area for passage and wintering Ardeidae, shorebirds and Anatidae, and a feeding area for Ardeidae and *Dendrocygna arborea* from nearby breeding sites. Concentrations of Ardeidae have included up to 60 *Egretta tricolor* and 300 *E. thula.* Breeding species include *Podilymbus podiceps, Gallinula chloropus* and *Himantopus himantopus.*
Other fauna: *Quiscalus niger bangsi* breeds in the mangroves, and *Pandion haliaetus* and *Falco columbarius* occur in winter.
Threats: Uncontrolled hunting is the only threat at present.
Research and conservation: The wetland has potential value for nature tourism and should be protected as an Animal Sanctuary.
References: Stoddart & Giglioli (1980).
Source: Patricia Bradley.
Criteria for inclusion: 3a.

Charles Bight Wetland and Sesuvium Swamp (15)

Location: 19°42'N, 79°59'W; 14 km east of the airstrip, Little Cayman.
Area: 77 ha. (Charles Bight 50 ha; Sesuvium Swamp 27 ha).
Altitude: 0-3m.
Province and type: 8.39.13; 07, 08 & 13.
Site description: A permanent saline lagoon and several seasonal brackish ponds in an extensive mangrove swamp; and a seasonal freshwater marsh with scattered pools (Sesuvium Swamp) to the east. Water levels are dependent on rainfall and evapotranspiration; the marsh dries out completely during the dry season. Sesuvium Swamp is the only herbaceous marsh of its type in the Cayman Islands.
Principal vegetation: Mangrove swamps with *Laguncularia racemosa* and *Conocarpus erectus* at Charles Bight; marshes with *Sesuvium microphyllum, S. portulacastrum* and *Typha domingensis* at Sesuvium Swamp.
Land tenure: Owned by the Crown (Cayman Islands Government). Access to the wetland is across private land.
Protection: None.
Land use: Some hunting at Charles Bight Wetland.
Waterfowl: Charles Bight Wetland is an important area for breeding and wintering waterfowl. Breeding species include *Podilymbus podiceps, Nyctanassa violacea, Dendrocygna arborea* (up to 27 birds recorded), *Himantopus himantopus* (up to 65 birds) and *Sterna albifrons.* Up to 170 *Anas discors* have been recorded in winter, along with small numbers of several other Anatidae. Little information is available for Sesuvium Swamp, but it is known to be an important feeding area for *Dendrocygna arborea.*
Other fauna: *Columba leucocephala* and *Quiscalus niger bangsi* breed. Fishes include *Gambusia* sp.
Threats: There is illegal hunting of *Dendrocygna arborea* and uncontrolled hunting of migrant Anatidae at Charles Bight Wetland. Sesuvium Swamp is very difficult of access and under no immediate threat.
Research and conservation: The wetlands constitute one of the most important breeding areas for the rare *Dendrocygna arborea* in the Cayman Islands and should be protected as Animal Sanctuaries. The wetlands have great potential value for nature tourism, particularly since Little Cayman is an island where natural pursuits are the main tourist attraction.
Source: Patricia Bradley.
Criteria for inclusion: 2a, 2b & 3a.

CUBA

INTRODUCTION

by **Orlando Garrido**

The Cuban Archipelago has a surface area of 110,922 km^2, 95% of which comprises the island of Cuba, 1.7% the island of La Juventud (Isle of Pines) and 3.3% the adjacent islets. The population is estimated at some 10 million.

The main island of Cuba is 1,258 km long and up to 191 km wide. The north coast is 3,209 km long, the south coast 2,537 km. Both coasts have numerous bays (e.g. Honda, Caba£as, Mariel, Habana, Matanzas, Nuevitas, Puerto Padre, Gibara, Banes, Nipe, Cienfuegos, Guantanamo and Santiago de Cuba) and offshore islets or cays (e.g. Romano, Coco, Real, Cantiles, Rosario and Largo del Sur).

The many lakes and lagoons include Las Playas, Ariguanabo, Del Tesoro, Cayo Redondo, Grande, La Leche, Sigua, La Redonda, Los Gatos and El Pesquero. The two principal marshes are Zapata on the main island and Lanier on La Juventud; the main delta marshes include Birama in the Cauto delta, those in the southwest and south of Sancti Spiritus Province, and those in the north of Santa Clara Province.

The rainy season extends from May to October, and the dry season from November to April. Rainfall is abundant and well distributed, and in general the climate is pleasant, with only occasional hurricanes.

A quarter of the main island is mountainous. The Sierra de los Organos, to the west of La Habana, reaches heights of up to 750m; the Sierra de Trinidad near the centre of the island rises to a peak at 1,100m; and the Sierra Maestra in the east, to a peak at 1,980m. There are extensive forests of pine and other species in some parts of the island of Cuba, especially in the west but to a lesser extent also in the east, and in various parts of the island of La Juventud.

Institutional Base for Wetland Conservation and Research

There are few organizations dedicated to conservation and/or research in Cuba, and all are governmental. They are as follows:

Direccion Nacional de Flora y Fauna; created in 1984 and responsible for the research and conservation of flora, fauna and the environment.

Confederacion Ornitologica; primarily concerned with exotic birds and birds in captivity.

Academia de Ciencias de Cuba (Instituto de Zoologia); created in the early 1960s to carry out scientific research.

Universidad de La Habana (Escuela de Biologia); primarily concerned with teaching activities, but also carries out research projects.

Centro Biologico de Managua; primarily concerned with maintaining exotic animals in captivity, including some species of waterfowl, but also carries out occasional research projects.

Ministerio de Agricultura (INDAF); concerned with research on game animals, as well as studies of the fishes of lakes and dams.

Progress in Wetland Conservation and Research

The following Nature Reserves (Reservas Naturales) have been established in Cuba:

El Veral, on the Guanahacabibes Peninsula
Maria la Gorda, on the Guanahacabibes Peninsula
Caguanes, on the north coast of Santa Clara Province
Cupeyal, on the north coast of Santa Clara Province
Jaguani, in the extreme east of the island.

All these reserves were established during the 1960s and are under the jurisdiction of the Academia de Ciencias.

Many other areas are protected as National Monuments, National Parks, Faunal Refuges and Natural Tourist Areas. Examples include the Cienaga de Zapata, the Cienaga de Lanier, and all the cays of the Cuban Archipelago, where the hunting and capture of wildlife are prohibited. The protection of the cays is of special importance because of their ecological fragility and great importance for wildlife. For example, 35,000 adult and 10,000 juvenile *Phoenicopterus ruber* were recently observed on Cayo Coco.

Some dams and lagoons are used for international sport fishing, e.g. Guama and Zaza, and various international shooting reserves have been established, e.g. Presa de Mamposton in Pinar del Rio Province and Laguna de la Redonda. A further international shooting reserve is currently being created on the outskirts of Birama in the Cauto Delta.

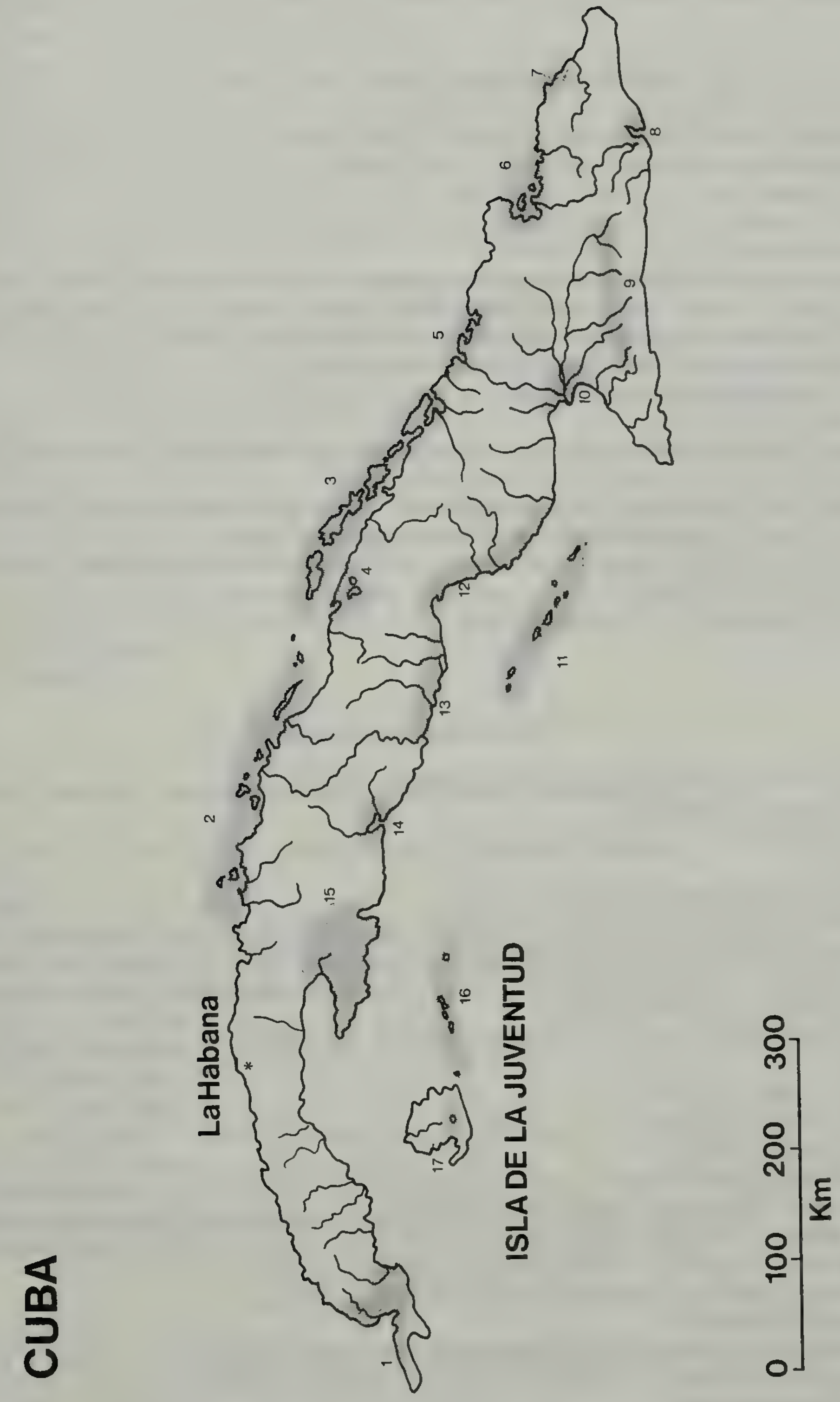
In recent years, the area of wetlands in Cuba has increased considerably, thanks to the State's water policy which has involved the creation of over 29 reservoirs and dams with capacities ranging from 40 to 1,020 million cubic metres.

A variety of research projects have been carried out in Cuba. Bird banding programmes were conducted in the 1940s and again in 1974. Around 1967, public protest resulted in the initiation of a programme for the control of *Dendrocygna bicolor* in the Jibaro rice fields in southern Sancti Spiritus Province. However, an analysis of ducks (*Dendrocygna bicolor, D. arborea* and *Anas bahamensis*) killed by 100 hunters during a 30 day period revealed that the damage caused by ducks feeding on rice was not serious; the damage caused by the hunters was much greater, but this was not taken into consideration. The programme of the Direccion Nacional de Flora y Fauna involves the banding of birds at various localities, and a complete study of the principal wetlands and waterfowl, including both native and migratory species since it appears that wintering populations are largely made up of migrants and not native birds as was widely supposed.

Major Threats to Wetlands and Waterfowl

Until relatively recently, many marshes were affected by fires set in the herbaceous vegetation to facilitate the collection of freshwater turtles, but with the creation of refuges and protective legislation, this problem appears to have disappeared.

Apart from fires, natural floods and droughts, there are no serious factors which might influence the deterioration of wetlands or waterfowl populations. However, *Dendrocygna* spp are hunted indiscriminately in some areas, despite the fact that there are regulations concerning their capture.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WETLANDS

No data sheets were received from Cuba. The site descriptions are based on personal communication with Orlando H. Garrido, and some material and literature provided by him.

Bahia de Guadiana and San Julian Marshes (1)

Location: 21°55'-22°10'N, 84°00'-84°55'W; at the western tip of Cuba between Golfo de Guanahacabibes and Ensenada de Cortes, Pinar del Rio Province.

Area: 67,500 ha.

Altitude: 0-10m.

Province and type: 8.39.13; 01, 07 & 08.

Site description: A complex of mangrove swamps, coastal brackish marshes, and numerous small brackish to saline lagoons along the north side of Peninsula de Guanahacabibes, around Bahia de Guadiana, and across the western tip of Cuba to Ensenada de Cortes. The principal lakes include Laguna de Lugones and Laguna del Jovero.

Principal vegetation: Mangrove swamps.

Land tenure: State owned.

Protection: Partly included in El Veral Nature Reserve, and partly in Maria la Gorda Nature Reserve.

Land use: A little tourist recreation; there is a tourist camp at the west end of the peninsula.

Waterfowl: The Cuban endemic *Rallus elegans ramsdeni* occurs.

Other fauna: The Cuban endemics *Dendroica petechia gundlachi* and *Agelaius assimilis* occur.

Threats: No serious threats.

Criteria for inclusion: 0.

Archipielago de Sabana (2)

Location: 22°35'N, 79°20'W to 23°15'N, 81°00'W; off the north coast between Cardenas and Caibarien, Matanzas Province.

Area: 335,000 ha.

Altitude: 0m.

Province and type: 8.39.13; 01, 03, 07 & 08.

Site description: An archipelago of offshore cays with mangrove swamps and coral reefs, 190 km long by up to 25 km wide, including Cayo Mono, Cayos del Pajonal and Cayo Fragoso; and the adjacent mainland coast with shallow sea bays, mangrove swamps, brackish coastal lagoons and some areas of salt pans.

Principal vegetation: Mangrove swamps, mainly *Rhizophora mangle* with some *Avicennia germinans.*

Land tenure: State owned.

Protection: None at present.

Land use: No information.

Waterfowl: The Cuban endemics *Ardea herodias repens* and *Rallus elegans ramsdeni* occur.

Other fauna: *Rostrhamus sociabilis plumbeus* and *Agelaius assimilis* occur in the coastal marshes; *Mimus gundlachii gundlachii* occurs on some cays; and *Dendroica petechia gundlachi* occurs in the mangroves. The Rat Hutia *Capromys auritus* is now confined to the central channels of Fragoso Cay at the eastern end of the archipelago.

Threats: No information.

Research and conservation: Some bird banding has been carried out by Garrido and the late Garcia Monta£a. All the cays in Cuba will eventually be protected by a law currently in the process of being adopted.

References: Garrido (1973b & in press); Varona (1980).

Source: Orlando H. Garrido.

Criteria for inclusion: 2a & 3a.

Archipielago de Camaguey (3)

Location: 22°40'N, 79°15'W to 21°30'N, 79°10'W; off the north coast between Caibarien and Bahia de Nuevitas.
Area: 450,000 ha.
Altitude: 0-60m.
Province and type: 8.39.13; 01, 03, 05, 06, 07 & 08.
Site description: An archipelago of numerous large and small offshore cays with mangrove swamps, tidal mudflats and coral reefs; and the adjacent shallow sea bays Bahia La Gloria and Bahia de Nuevitas, with extensive mangrove swamps, brackish lagoons and marshes. The archipelago is 250 km long and up to 35 km wide, and includes Cayo Santa Maria, Cayo Coco, Cayo Romano, Cayo Guajaba and Cayo Sabinal.
Principal vegetation: Mangrove swamps, mainly *Rhizophora mangle* with some *Avicennia germinans*; deciduous woodland, particularly on Cayo Romano and Cayo Guajaba.
Land tenure: State owned.
Protection: The three cays, Coco, Romano and Guajaba, are protected in reserves.
Land use: Some cultivation on Cayo Romano and Cayo Guajaba.
Waterfowl: *Phoenicopterus ruber* occurs in very large numbers and is reported to breed in Bahia de Nuevitas. 35,000 adults and 10,000 immatures were observed in 1983 on Cayo Coco. The rare endemic race of the Sandhill Crane *Grus canadensis nesiotes* has been reported from Cayo Romano, and *Ardea herodias repens* occurs.
Other fauna: *Rostrhamus sociabilis plumbeus* occurs in the marshes and *Accipiter gundlachii* has been reported on Cayo Coco. *Mimus gundlachii gundlachii* occurs on some cays, and *Dendroica petechia gundlachi* breeds throughout. A population of the Zapata Sparrow *Torreornis inexpectata* has recently been discovered on Cayo Coco, and given subspecific status (*varonai*).
Threats: Monkeys have been introduced on Cayo Guajaba.
References: Garrido (1976 & in press); Acosta & Berovides (undated).
Source: Orlando H. Garrido.
Criteria for inclusion: 123.

Turiguano Swamp and Cayo Los Pajaros (4)

Location: 22°10'N, 78°35'W; 10 km north of Moron, Camaguey Province.
Area: 77,500 ha.
Altitude: 0-5m.
Province and type: 8.39.13; 01, 03, 06, 07 & 08.
Site description: A complex of brackish coastal lagoons, mangrove swamps and tidal mudflats around a shallow sea bay, and offshore cays.
Principal vegetation: Mangrove swamps.
Land tenure: State owned.
Protection: No information.
Land use: No information.
Waterfowl: *Ardea herodias repens* breeds on Cayo Los Pajaros.
Other fauna: No information.
Threats: No information.
Research and conservation: A hunting reserve may be established in the area.
Criteria for inclusion: 0.

Manati and Puerto Padre (Punta Malagueta) (5)

Location: 21°15'N, 76°20'W; 50 km northwest of Holguin.
Area: 40,000 ha.
Altitude: 0m.
Province and type: 8.39.13; 07 & 08.

Site description: A chain of brackish coastal lagoons with mangrove swamps and offshore coral reefs.
Principal vegetation: Mangrove swamps.
Land tenure: State owned.
Protection: No information.
Land use: No information.
Waterfowl: No information.
Other fauna: No information.
Threats: No information.
Criteria for inclusion: 0.

Bahia de Nipe (6)

Location: 20°47'N, 75°40'W; southwest of Banes.
Area: 67,500 ha.
Altitude: 0-5m.
Province and type: 8.39.13; 01, 07 & 08.
Site description: A complex of large brackish coastal lagoons and mangrove swamps around a shallow sea bay with coral reefs.
Principal vegetation: Mangrove swamps.
Land tenure: State owned.
Protection: No information.
Land use: No information.
Waterfowl: No information.
Other fauna: No information.
Threats: No information.
Criteria for inclusion: 0.

Moa and Punta Caba£as (7)

Location: 20°40'N, 74°50'W; 90 km ESE of Banes.
Area: 15,000 ha.
Altitude: 0m.
Province and type: 8.39.13; 03 & 06.
Site description: Extensive intertidal mudflats along a sea coast, with small offshore islands and coral reefs.
Principal vegetation: No information.
Land tenure: State owned.
Protection: No information.
Land use: No information.
Waterfowl: No information.
Other fauna: No information.
Threats: No information.
Criteria for inclusion: 0.

Guantanamo Bay (8)

Location: 20°00'N, 75°10'W; 20 km SSE of Guantanamo.
Area: 15,000 ha.
Altitude: 0m.
Province and type: 8.39.13; 01, 02, 07 & 08.
Site description: A sea bay and the estuarine system of the Rio Jaibo, with fringing mangroves swamps and brackish marshes.
Principal vegetation: Mangrove swamps.

Land tenure: State owned.
Protection: No information.
Land use: No information.
Waterfowl: *Rallus elegans ramsdeni* is known to occur.
Other fauna: No information.
Threats: No information.
Criteria for inclusion: 0.

Sierra Maestra Lakes (9)

Location: 20°05'-20°15'N, 76°15'-76°58'W; between 50 and 120 km west of Santiago de Cuba.
Area: 6,000 ha.
Altitude: c.120m.
Province and type: 8.39.13; 12.
Site description: A group of four freshwater lakes in the foothills of the Sierra Maestra, approximately 700, 800, 1,600 and 2,900 ha in size.
Principal vegetation: No information.
Land tenure: State owned.
Protection: No information.
Land use: No information.
Waterfowl: No information.
Other fauna: No information.
Threats: No information.
Criteria for inclusion: 0.

Cienaga de Birama and the Rio Cauto Delta (10)

Location: 20°35'N, 77°10'W; north of Manzanillo.
Area: 67,500 ha.
Altitude: 0-5m.
Province and type: 8.39.13; 01, 02, 06, 07, 08 & 09.
Site description: The extensive estuarine system of the Rio Cauto with large brackish lagoons, mangrove swamps and intertidal mudflats; on the Golfo de Guacanayabo.
Principal vegetation: Mangrove swamps.
Land tenure: State owned.
Protection: No information.
Land use: No information.
Waterfowl: *Phoenicopterus ruber* is reported to breed, and *Ardea herodias repens* and *Rallus elegans ramsdeni* are known to occur.
Other fauna: *Dendroica petechia gundlachi* breeds in the mangroves.
Threats: No information.
Criteria for inclusion: 0.

Jardines de La Reina (11)

Location: 20°31'N, 78°19'W to 21°08'N, 79°27'W; off the Golfo de Ana Maria on the south coast.
Area: 75,000 ha.
Altitude: 0-2m.
Province and type: 8.39.13; 06, 07 & 08.
Site description: A chain of numerous small cays stretching for 135 km, with mangrove swamps, brackish lagoons and marshes, intertidal mudflats and coral reefs.
Principal vegetation: Mangrove swamps.

Land tenure: State owned.
Protection: No information.
Land use: No information.
Waterfowl: *Phoenicopterus ruber* is an abundant non-breeding visitor, and *Ardea herodias repens* is known to occur.
Other fauna: *Dendroica petechia gundlachi* breeds in the mangroves.
Threats: No information.
Criteria for inclusion: 1c.

Golfo de Ana Maria (12)

Location: 20°42'N, 78°00'W to 21°35'N, 79°10'W; on the south coast between Rio Najasa and Rio Jatibonico.
Area: 85,000 ha.
Altitude: 0-5m.
Province and type: 8.39.13; 01, 02, 03, 06, 07, 08 & 09.
Site description: A chain of brackish to saline coastal lagoons, marshes and mangrove swamps along 180 km of coast between the mouths of the Rio Najasa and the Rio Jatibonico, including the delta marshes of the Malafama, Altamira and San Pedro rivers, and some small offshore islands (the Ana Maria Cays).
Principal vegetation: Mangrove swamps.
Land tenure: State owned.
Protection: No information.
Land use: No information.
Waterfowl: No information.
Other fauna: Cabrera's Hutia, a small rodent of the genus *Capromys*, is endemic to the Ana Maria Cays.
Threats: No information.
References: Varona (1980).
Criteria for inclusion: 2a.

Jibaro Wetlands (13)

Location: 21°00'N, 79°10'-80°00'W; south of Sancti Spiritus.
Area: 37,500 ha.
Altitude: 0-5m.
Province and type: 8.39.13; 02, 07, 08, 09 & 17.
Site description: A strip of coastal brackish lagoons, marshes, mangrove swamps and extensive areas of rice cultivation stretching for 90 km from the delta of the Rio Agabama to the Rio Jatibonico, and including the deltas of several smaller rivers.
Principal vegetation: Mangrove swamps and rice fields.
Land tenure: State owned.
Protection: No information.
Land use: No information.
Waterfowl: *Plegadis falcinellus*, *Rallus elegans ramsdeni* and *R. maculatus* are known to occur. The rice paddies formerly supported large populations of *Dendrocygna bicolor*, *D. arborea* and *Anas bahamensis*, but the numbers declined drastically following the commencement of a pest control programme in 1974.
Other fauna: *Asio flammeus* has recently been discovered breeding in the rice fields.
Threats: No information.
Research and conservation: Some research was conducted by Garrido on the feeding habits of *Dendrocygna* spp and *Anas bahamensis* in 1967, following complaints from rice growers that the birds were damaging their crops.
References: Godinez (undated).
Source: Orlando H. Garrido.
Criteria for inclusion: 0.

Bahia de Cienfuegos (14)

Location: 22°05'N, 80°26'W; at Cienfuegos.
Area: 8,000 ha.
Altitude: 0m.
Province and type: 8.39.13; 07.
Site description: A large brackish coastal lagoon with narrow connection with the sea. The town of Cienfuegos is situated on the northeast shore.
Principal vegetation: No information.
Land tenure: State owned.
Protection: No information.
Land use: No information.
Waterfowl: No information.
Other fauna: No information.
Threats: No information.
Criteria for inclusion: 0.

Zapata Swamp and Las Salinas (15)

Location: 22°00'-22°40'N, 80°50'-82°10'W; 100 km southeast of La Habana, Matanzas Province.
Area: 340,000 ha.
Altitude: 0-5m.
Province and type: 8.39.13; 01, 02, 04, 05, 06, 07, 08 & 12.
Site description: A vast complex of brackish to saline lagoons and marshes, mangrove swamps and intertidal mudflats along the Zapata Peninsula (a pleistocene limestone peninsula), and between the peninsula and the mainland coast; also long sandy beaches and some rocky shores on the outer coasts, and an area of abandoned salt pans (Las Salinas). The main swamp is between Ensenada de la Broa and Bahia de Cochinos; this includes Laguna del Tesoro, the only significant freshwater lake in the marshes and the source of the Rio Hatiguanico. Most of the marshes dry out in the dry season (November to April), but there are numerous small hollows that remain flooded (casimbas) and provide a dry season refuge for crocodiles and turtles.
Principal vegetation: Mangrove swamps; extensive swamps of *Cladium jamaicensis* with wooded hummocks.
Land tenure: State owned.
Protection: Largely included within the Zapata National Park (300,000 ha).
Land use: Some recreation and nature tourism, mainly around Laguna del Tesoro.
Waterfowl: An extremely important area for a wide variety of breeding and wintering waterfowl; about 70 species have been recorded. The Zapata Rail *Cyanolimnas cerverai* is apparently confined to the swamp. The bird is not common, but recent observations indicate that it may be more widespread in the swamp that was previously supposed, and it appears not to be in any real danger. The swamp is also the most important breeding area for the endangered Cuban race of the Sandhill Crane *Grus canadensis nesiotes*. The population in the swamp is currently thought to number 30-40 birds. Other resident species include *Pelecanus occidentalis*, *Phalacrocorax olivaceus*, *Anhinga anhinga*, *Ixobrychus exilis*, *Nycticorax nycticorax*, *Egretta caerulea*, *E. tricolor*, *E. rufescens*, *E. thula*, *E. alba*, *Ardea herodias repens*, *Mycteria americana*, *Eudocimus albus*, *Plegadis falcinellus*, *Ajaia ajaja*, *Oxyura jamaicensis*, *Aramus guarauna*, *Rallus elegans ramsdeni*, *R. maculatus*, *Porzana flaviventer*, *Gallinula chloropus*, *Porphyrula martinica*, *Fulica americana*, *Jacana spinosa* and *Charadrius vociferus*. *Phoenicopterus ruber* is a regular non-breeding visitor in large numbers; up to 3,000 have been observed at Las Salinas. Many Nearctic Ardeidae, Anatidae, shorebirds and Laridae are common on passage and in winter, and *Anas discors* is abundant.
Other fauna: There are two passerines endemic to the swamp; the rare Zapata Wren *Ferminia cerverai*, and the nominate race of the Zapata Sparrow *Torreornis inexpectata*. The Snail Kite *Rostrhamus sociabilis plumbeus* is still very common, and the rare Gundlach's Hawk *Accipiter gundlachii* breeds. The endangered Bachman's Warbler *Vermivora bachmani* was observed twice by Garrido in the early 1960s. *Pandion haliaetus* and *Falco peregrinus* occur in winter.

The very rare rodent *Capromys nanus* is known only from the swamp and has not been reported since 1937. The manatee *Trichechus manatus* occurs in the Rio Hatiguanico. The Cuban Crocodile *Crocodylus rhombifer* still occurs in the wild, but most individuals have been translocated to enclosures at Laguna de Tesoro where there has been some hybridization with captive *C. acutus*. Other reptiles include *Chamaeleolis chamaeleonides*, the lizards *Anolis luteogularis calceus* (endemic to the swamp) and *A. allisoni*, and the freshwater turtle *Chrysemys decussata*. Amphibians include the frog *Osteopillus septentrionalis*.
Threats: An introduced mongoose *Herpestes auropunctatus* has recently invaded the swamp and could pose a serious threat to the endemic wren, and accidental fires could seriously threaten the endemic rail.
References: Bruner (1934); Garrido & Garcia Monta£a (1975); Garrido (1980 & in press); Varona (1980); WWF Red Data Book.
Source: Orlando H. Garrido.
Criteria for inclusion: 123.

Archipielago de Los Canarreos (16)

Location: 21°38'N, 81°10'-82°30'W; east of Isla de La Juventud (Isle of Pines).
Area: 15,000 ha.
Altitude: 0-5m.
Province and type: 8.39.13; 03, 05 & 08.
Site description: A chain of cays stretching for 140 km, to the east of Isla de La Juventud. The principal cays are Cayo Largo, Cayo Rosario and Cayo Cantiles.
Principal vegetation: Mangrove swamps; the terrestrial vegetation is dominated by the palm *Coccothrinax* sp.
Land tenure: State owned.
Protection: No information.
Land use: A densely populated archipelago with extensive tourist development.
Waterfowl: *Ardea herodias repens* occurs.
Other fauna: There is an endangered subspecies of the West Indian Red-bellied Woodpecker *Centurus superciliaris florentinoi* on Cayo Largo, and an endemic rodent *Capromys garridoi* (Garrido's Hutia) on Cayo Largo and some of the smaller cays.
Threats: Development for tourism poses a threat on Cayo Largo, and monkeys have been introduced on Cayo Cantiles and Cayo Rosario.
References: Bond (1950); Garrido & Schwartz (1969 & undated); Varona (1980); Garrido & Lee (undated); Garrido (in press).
Source: See references.
Criteria for inclusion: 2a & 3a.

Cienaga de Lanier and Ensenada de La Siguanea (17)

Location: 21°35'N, 82°35'-83°00'W; south-central and western Isla de La Juventud (Isle of Pines).
Area: 45,000 ha.
Altitude: 0-10m.
Province and type: 8.39.13; 07, 12 & 16.
Site description: A belt of small fresh to brackish lakes and marshes across south-central Isla de La Juventud from Ensenada de La Siguanea to the east coast, and a chain of brackish coastal lagoons, marshes and wet savanna along the east shore of Ensenada de La Siguanea north to Los Indios.
Principal vegetation: No information.
Land tenure: State owned.
Protection: Cienaga de Lanier is included in a protected area, but the details are unknown.
Land use: No information.

Waterfowl: One of the two largest remaining populations of the endangered Cuban Sandhill Crane *Grus canadensis nesiotes* is found in the marshes and wet savannas between Siguanea and Los Indios; recent estimates put the population at between 30 and 40 birds. Other noteworthy waterfowl occurring in the area include *Ardea herodias repens, Dendrocygna arborea, Rallus elegans ramsdeni* and *R. maculatus.*

Other fauna: *Agelaius assimilis* and *Dendroica petechia gundlachi* breed. There is a tiny population of the endangered Cuban Crocodile *Crocodylus rhombifer* in the marshes, one of only two populations still existing in the wild. *Caiman crocodilus fuscus* has been introduced and is rather common.

Threats: The introduced population of *Caiman crocodilus fuscus* poses a serious threat to the tiny remnant population of *Crocodylus rhombifer.*

References: WWF Red Data Book; Garrido (in press).

Source: See references.

Criteria for inclusion: 2a & 3a.

DOMINICA

INTRODUCTION

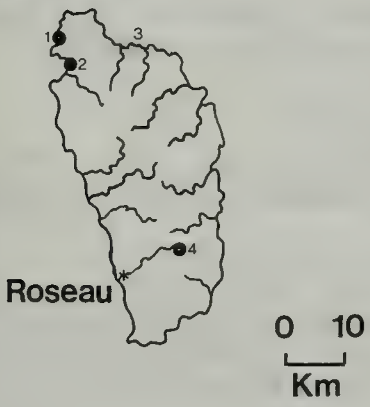
No information was received on the current situation in Dominica. The following account is based on James (1979), IUCN (1982) and Putney (1982).

Dominica, the most northerly of the Windward Islands, is a mountainous volcanic island 751 km^2 in extent, with peaks rising to 1,447m. The annual rainfall ranges from under 1,200 mm on the west coast to over 7,600 mm in the highlands. Much of the island remains forested, with dry woodland in the western lowlands and rain and cloud forest in the interior. Dominica became fully independent in 1979; it has a population of about 80,000 and an economy based on agriculture, particularly the cultivation of bananas and coconuts. The island was devastated by Hurricane David in 1979 and the tourist industry is only now beginning to recover.

Dominica possesses few wetlands; there are no salt ponds and only four small stands of mangroves. However, there are several large patches of *Pterocarpus officinalis* swamp forest with associated freshwater marshes, and many smaller stands of *P. officinalis*, in the northern third of the island. Most of the swamp forest is privately owned and under threat from agricultural expansion. (This type of forest is an endangered ecosystem almost throughout the Caribbean).

The government department responsible for conservation is the Forestry Division in Roseau. The National Parks and Protected Areas Act of 1975 provides the legal basis for a park system. One national park has been established to date, the Morne Trois Pitons National Park (6,840 ha) established in 1975. This contains many interesting volcanic features including the world's second largest boiling lake and a small freshwater lake. There is also a Forest Reserve of 22,000 ha in the north central part of the island. Potential units in Dominica's National Park System include three proposed reserves incorporating significant tracts of swamp forest; the Cabrits National Park and Indian River Natural Monument in the northwest, and the Hampstead National Seashore on the north coast.

DOMINICA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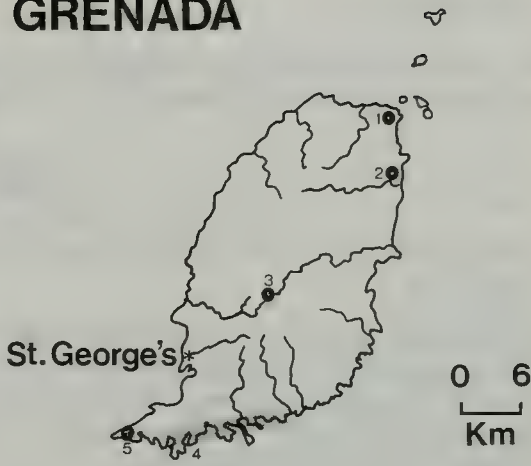
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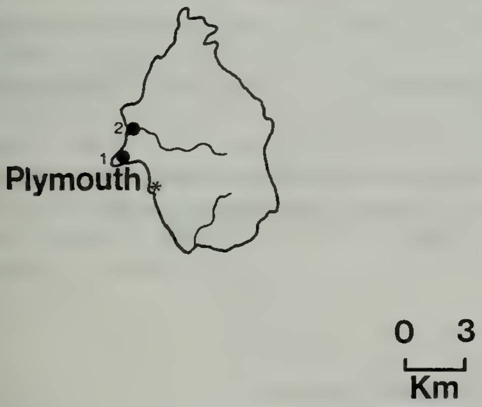
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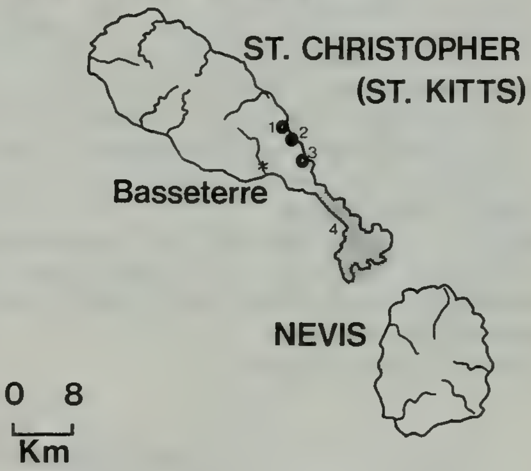
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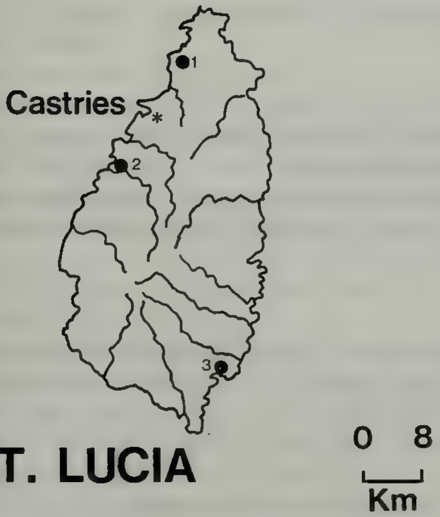
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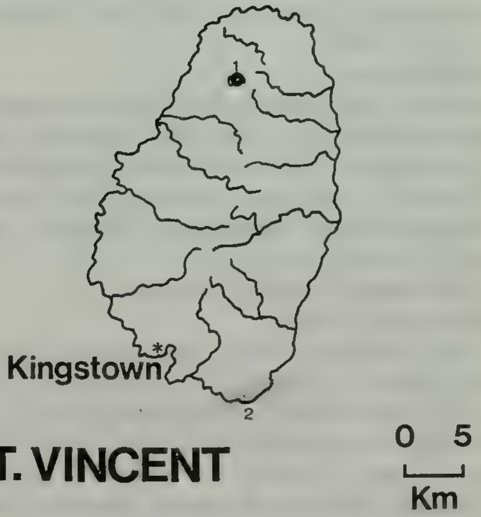
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WETLANDS

No recent information is available on the wetlands of Dominica. The following site descriptions are based on James (1979), Putney (1982) and Putney *et al* (1983).

Cabrits Swamp (1)

Location: 15°35'N, 61°28'W; at the base of the Cabrits Peninsula, on the northwest coast.
Area: 45 ha.
Altitude: 0m.
Province and type: 8.41.13; 07, 08, 09, 13 & 18.
Site description: A complex of fresh to brackish marshes, waterlogged grassland and swamp forest with some mangroves. The swamp is fed by three streams entering along its eastern boundary, and drained by one channel at its southeastern edge; sea water flows into the marsh via this channel during high tides.
Principal vegetation: Marshes with *Acrostichum* spp and *Eleocharis mutata*, and wet grassland and swamp forest with *Annona glabra, Pterocarpus officinalis, Haematoxylum campechianum* and *Laguncularia racemosa*; dry scrub and woodland in surrounding areas.
Land tenure: State owned.
Protection: None.
Land use: Some grazing and cultivation nearby.
Waterfowl: A nesting area for Ardeidae (*Bubulcus ibis, Butorides virescens* and *Egretta caerulea*), and a feeding area for migratory Anatidae and other waterfowl.
Other fauna: The tree lizard *Anolis bimaculatus oculatus* is common; there is a rich fish fauna including freshwater species and the juveniles of marine species; and the crabs *Cardisoma guanhumi* and *Uca* spp are abundant. The sea turtles *Chelonia mydas* and *Eretmochelys imbricata* nest on nearby beaches.
Threats: None known.
Research and conservation: The Cabrits Peninsula has been identified by Putney as an area with multiple resource values, and has been incorporated in a proposed national park.
References: James (1979); Putney (1982); Putney *et al* (1983).
Source: See references.
Criteria for inclusion: 3a.

Indian River Flats and Lagon (2)

Location: 15°34'N, 61°28'W; near Glanvillia and Portsmouth, on the northwest coast.
Area: c.45 ha.
Altitude: 0m.
Province and type: 8.41.13; 09, 13, 16 & 18.
Site description: Freshwater marshes, seasonally flooded grassland and swamp forest on the floodplain of the lower Indian River and at Lagon, to the northwest.
Principal vegetation: Swamp forest dominated by *Pterocarpus officinalis*, with *Annona glabra, Pandanum* sp, *Chimarrhis cymosa* and *Pavonia scabra*; marshes with *Acrostichum* spp and *Eleocharis mutata.*
Land tenure: Privately owned.
Protection: None.
Land use: Boat rides up the Indian River into the *Pterocarpus* swamp provide a popular tourist attraction. The towns of Glanvillia and Portsmouth are close to the wetlands, and there is cultivation in surrounding areas.
Waterfowl: Similar to Cabrits Swamp (site 1).
Other fauna: Similar to Cabrits Swamp (site 1).
Threats: Clearing of swamp forest for the cultivation of coconuts and bananas.
Research and conservation: The marsh and swamp forest formations of the Indian River have been incorporated in a proposed protected area, the Indian River Natural Monument.

References: James (1979); Putney (1982).
Source: See references.
Criteria for inclusion: 3a.

North Coast Swamps (3)

Location: 15°35'N, 61°22'W; on the north coast between Thibaud and Wesley.
Area: Unknown.
Altitude: Near sea level.
Province and type: 8.41.13; 08, 09, 13 & 18.
Site description: *Pterocarpus* swamp forest and freshwater marshes extending inland for 3-4 km along the lower stretches of several rivers and streams (particularly the Torite, Anse de Mai, Salee and Woodford Hill Rivers), and small patches of mangroves at Hampstead Bay and near the mouth of the Anse de Mai River. Most of the *Pterocarpus* forest and the two mangrove swamps are found on a ten kilometre stretch of coastal lowlands between the Torite and Woodford Hill Rivers.
Principal vegetation: Mangrove swamps with *Laguncularia racemosa*, swamp forest with *Pterocarpus officinalis* and some *Annona glabra*, and freshwater marshes with *Acrostichum* spp and *Eleocharis mutata.*
Land tenure: Privately owned.
Protection: None.
Land use: Cultivation and some tourism in surrounding areas.
Waterfowl: Similar to Cabrits Swamp (site 1).
Other fauna: Similar to Cabrits Swamp (site 1).
Threats: Clearing of swamp forest for the cultivation of coconuts and bananas.
Research and conservation: The northeast coast of Dominica has been identified by Putney as an area with multiple resource values. Some of the swamp forest and the two mangrove swamps have been incorporated in a proposed protected area, the Hampstead National Seashore, extending from Sandwich Bay at Thibaud to Wesley.
References: James (1979); Putney (1982).
Source: See references.
Criteria for inclusion: 3a.

Lakes in Morne Trois Pitons National Park (4)

Location: 15°21'N, 61°19'W; in the south-central highlands northeast of Roseau.
Area: A few ha.
Altitude: c.850m.
Province and type: 8.41.13; 12.
Site description: A volcanic lake at boiling temperature and a small freshwater lake, on the slopes of Morne Trois Pitons (1,387m).
Principal vegetation: Humid cloud forest in surrounding areas.
Land tenure: Public land (state owned).
Protection: Protected within the Morne Trois Pitons National Park (6,840 ha) established in 1975.
Land use: Tourism in the National Park.
Waterfowl: No information.
Other fauna: No information.
Threats: None known.
Research and conservation: The boiling lake is the second largest of its type in the world. The National Park contains the largest tract of unaltered cloud forest in the Lesser Antilles.
References: IUCN (1982); Putney (1982).
Source: See references.
Criteria for inclusion: 3b.

DOMINICAN REPUBLIC

INTRODUCTION

by **Cecilia Hernandez and Tomas Vargas**

The Dominican Republic, with its offshore islands of Saona, Beata and Catalina, covers 48,442 km^2 and comprises 74% of the island of Hispaniola, the remainder being in Haiti. In 1980, the population was estimated at 5,430,000.

According to the classification of Holdridge (1967), nine life zones and seven transition zones are represented in the Dominican Republic:

a) Subtropical montane shrub (2.07% of the country).
b) Dry subtropical forest (20.25%), represented in Parque Nacional del Este and Parque Nacional Isla Cabritos.
c) The transition zone between dry subtropical forest and humid subtropical forest (0.31%).
d) The transition zone between humid subtropical forest and dry subtropical forest (1.03%), represented in Parque Nacional del Este.
e) Humid subtropical forest (45.70%), represented in Parque Nacional del Este and Parque Nacional Jose del C. Ramirez.
f) The transition zone between humid subtropical forest and very humid subtropical forest (0.32%).
g) Very humid subtropical forest (14.5%), represented in Parque Nacional Los Haitises and Parque Nacional J. Armando Bermudez.
h) The transition zone between very humid subtropical forest and subtropical rain forest (0.05%).
i) Subtropical rain forest (0.12%).
j) The transition zone between humid low montane forest and dry low montane forest (0.05%).
k) Humid low montane forest (6.63%), represented in Parque Nacional Jose del C. Ramirez and Parque Nacional J. Armando Bermudez.
l) The transition zone between humid low montane forest and very humid low montane forest (0.50%).
m) Very humid low montane forest (7.34%), represented in Parque Nacional Jose del C. Ramirez and Parque Nacional J. Armando Bermudez.
n) The transition zone between very humid low montane forest and low montane rain forest (0.04%).
o) Low montane rain forest (0.07%), represented in Parque Nacional Jose del C. Ramirez.
p) Very humid montane forest (0.63%), represented in Parque Nacional Jose del C. Ramirez and Parque Nacional J. Armando Bermudez.

The mountains of the Dominican Republic consist of four parallel mountain chains extending from the northwest to the southeast: Cordillera Central, Cordillera Septentrional, Sierra de Neiba and Sierra de Bahoruco.

The climate is humid tropical with great regional and local variations. Rainfall is high throughout the year, with considerable daily variation, and evaporation is intense. The period of highest rainfall is from May to November and the period of least rainfall, from November to April.

The existing information on wetlands in the Dominican Republic is very limited. In 1980, Bonnelly de Calventi and Garcia de Geralde drew up an inventory of the nation's water bodies on the basis of existing maps. According to these authors, the Dominican Republic possessed 270 lakes, lagoons and ponds varying in size from 0.01 to 25.75 km. However, it is thought that many of these have since disappeared. One of the main causes has been the drainage of wetlands for agriculture and pasture land, a frequent activity in the Dominican Republic in recent years. Other causes include the extraction of sand and the exploitation of salt at saline lagoons. On the other hand, after Hurricane David in 1979, some wetlands increased in size. This was the case at Lago Enriquillo, the largest wetland in the country and perhaps the best studied.

Institutional Base for Wetland Conservation and Research

Real progress in the study and conservation of natural resources, including wetlands, did not begin until 1978. However, a variety of institutions and other bodies with interests in wildlife and conservation had existed before this time, and many of these are still active today. Some have reorientated their work while others have been modified. The organizations dedicated to conservation and/or research at the present time are listed below. Most include wetlands and waterfowl within their programmes:

- *Departamento de Vida Silvestre*, responsible for the management and conservation of the nation's wildlife.
- *Departamento de Recursos Pesqueros*, responsible for carrying out research on marine flora and fauna, particularly from the point of view of commercial development but with regard for conservation.
- *Departamento de Inventario de Recursos Naturales.*
- *Departamento de Tierras y Aguas.*
- *Departamento de Educacion Ambiental.*
- *Centro de Biologia Marina*, Universidad Autonoma de Santo Domingo (CIBIMA-UASD); this carries out research on the commercial exploitation of marine resources, and also conducts some studies at inland waters.
- *Jardin Botanico Nacional "Dr Rafael Moscoso".*
- *Direccion Nacional de Parques*, responsible for the development, administration, control and management of a system of protected areas with a view to conserving and perpetuating the nation's natural and cultural heritage.
- *Museo Nacional de Historia Natural (MNHN).*
- *Parque Zoologico Nacional*, concerned with public education, recreation and research.
- *Direccion General de Foresta.*
- A number of Ecological Societies and Conservation Groups, including:
    - *Sociedad Ecologica del Cibao (SOECI).*
    - *Sociedad Dominicana para la Conservacion de los Recursos Naturales.*
    - *Instituto Dominicano de Bioconservacion.*
    - *Grupo Ambiente de la UCMM.*
    - *Junta Campesina para el Desarrollo Forestal de la Provincia de Peravia*, Bani
    - *Sociedad Dominicana de Ornitologia.*
    - Twenty-four Ecological Societies and five Environmental Education Groups (Grupos de Educacion Ambiental).

Progress in Wetland Conservation and Research

The Dominican Republic currently has eighteen protected areas, included within three categories:

- National Parks
    - Los Haitises, established 1976
    - Cabo Frances Viejo, established 1964
    - De Puerto Plata, established 1971
    - Litoral del Sur, established 1968
    - J. Armando Bermudez, established 1956
    - Jose del C. Ramirez, established 1958
    - Isla Cabritos, established 1974
    - Del Este, established 1975
    - Monte Cristi, established 1983
    - Jaragua, established 1983
    - Sierra de Bahoruco, established 1983
- Scientific Reserves
    - La Cacatica, established 1976
    - Loma Isabel de Torres, established 1983
    - Valle Nuevo, established 1983
    - Lagunas Redonda y Limon, established 1983

- Laguna de Cabral o Rincon, established 1983
- Cayos Siete Hermanos, established 1983

National Historical Parks

- Zona de la Vega Vieja, established 1977

In 1983, the Departamento de Vida Silvestre completed a study on the Barahona Peninsula in the south and southeast of the country; this includes various wetlands such as Laguna Rincon and Laguna de Oviedo. Two protected areas were created as a result of this study; Parque Nacional Jaragua, which includes Laguna de Oviedo, and Reserva Cientifica Laguna de Cabral or Rincon. The study, which also involved the Direccion Nacional de Parques, the Museo Nacional de Historia Natural and the Jardin Botanico, was to a considerable extent responsible for preventing a large part of the area from being buried under tons of domestic sewage in an agro-industrial project. The sewage was to have been brought in from the U.S.A. by the Atlantic Forests Products Company.

Projects currently in progress concerning wetlands and their fauna include the following:

a) A study of Lago Enriquillo with a view to proposing an extension to the Parque Nacional Isla Cabritos which would give protection to the lake itself (Departamento de Vida Silvestre).
b) An inventory and evaluation of the different types of ecosystems in the Dominican Republic, with a view to the management and exploitation of wildlife (Departamento de Vida Silvestre).
c) A wetlands programme including inventory projects covering coastal lagoons, mangroves, sea-grass beds and coral reefs (CIBIMA-UASD).
d) Biological investigations of aquatic fauna and flora (CIBIMA-UASD).
e) A programme for non-traditional aquatic resources (CIBIMA-UASD).
f) A conservation programme for aquatic resources and environmental protection (CIBIMA-UASD).
g) A study of the fauna of the Gran Ca£ada in the Jardin Botanico Nacional (MNHN).
h) Biological and ecological studies of marine turtles (MNHN).
i) Studies of the biology and reproduction of species in Lago Enriquillo (MNHN).

Projects already completed include:

a) The development of fishing in the Dominican Republic (Instituto Dominicano de Tecnologia).
b) A study of the natural resources of Laguna del Rincon (Secretaria de Estado de Agricultura).
c) Research on six habitats important for the Dominican Republic's indigenous fauna: II Laguna Saladilla and III Laguna Salada (Universidad Nacional Pedro Henriquez Ure£a).
d) A study of wildlife areas on the Barahona Peninsula and Isla Beata, and proposal for the creation of a National Park (Departamento de Vida Silvestre, MNHN and Direccion Nacional de Parques).
e) A cartographic inventory of the inland water bodies of the Dominican Republic (CIBIMA-UASD).

Major Threats to Wetlands and Waterfowl

Because of the lack of information on the wetlands of the Dominican Republic, it is impossible to determine the full extent to which these ecosystems are threatened. However, it is known that wetlands are under threat from a variety of sources including drainage for agriculture and pasture land, the felling and burning of mangroves and other vegetation bordering lakes and lagoons, and excessive fishing, particularly at those wetlands around which there are human populations who depend on this activity as a means of subsistence.

Other detrimental activities having a direct effect on waterfowl populations include: the use of pesticides; egg-collecting, particularly the eggs of species of Ardeidae, Threskiornithidae, Anatidae, Rallidae and Laridae; excessive hunting practiced without any effective controls; the mining of sand and stone for construction purposes, which is posing a serious threat in some estuaries; and tourist development without prior study of the environmental impact.

In recent years, the country's wetlands have been exposed to new threats such as the dumping of industrial waste and the establishment of shrimp-farming projects. The latter problem is apparent in the recently created Monte Cristi National Park, where there is a proposal to exploit the natural riches of the area in the development of a shrimp industry.

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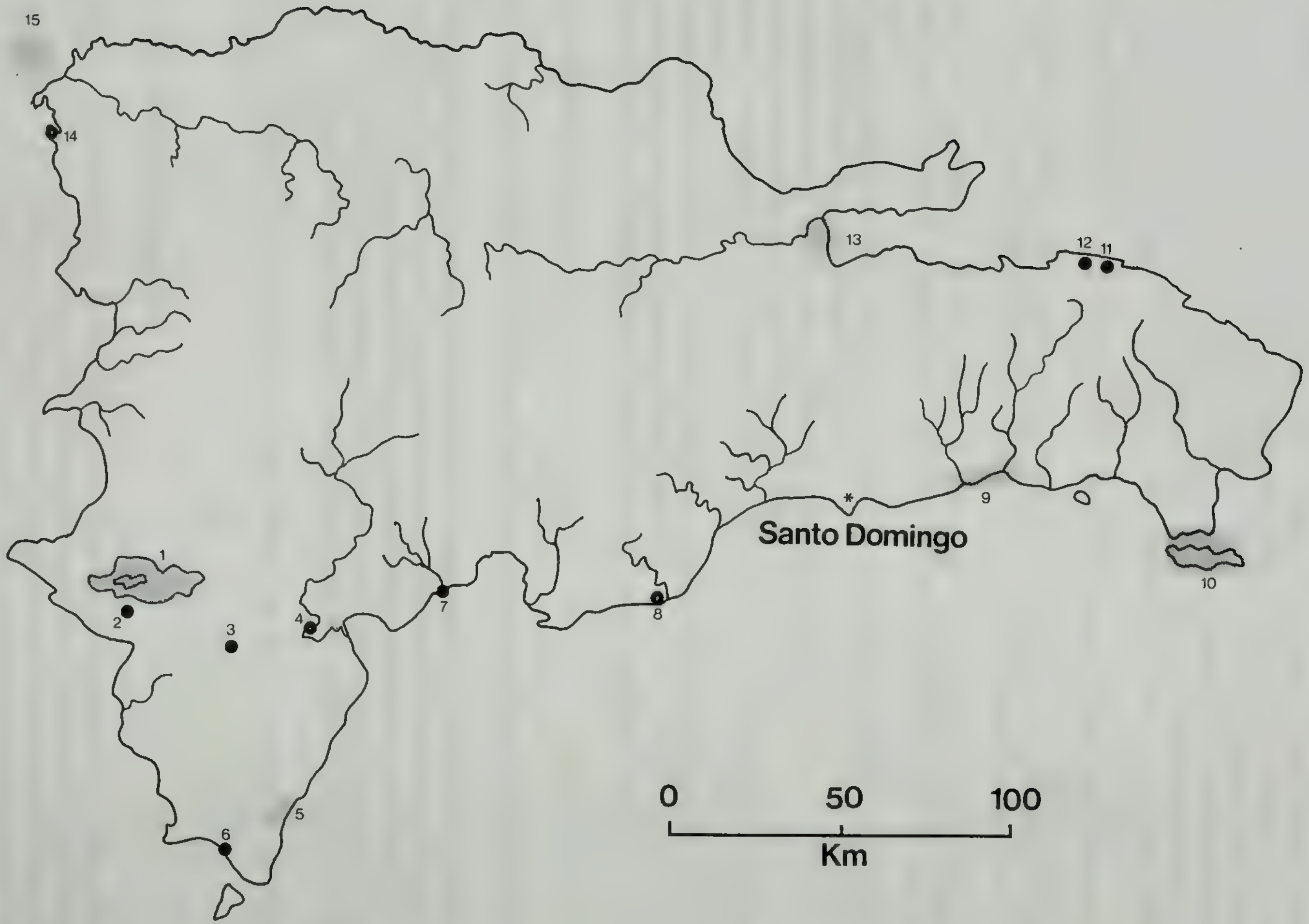
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WETLANDS

Site descriptions based on data sheets compiled by Cecilia Hernandez and Tomas A. Vargas of the Departamento de Vida Silvestre, with information from Venecia Alvarez, Idelisa Bonnelly de Calventi, Geraldino Caminero, Julio Cicero, Jurgen Czerwenka, Maria E. Feliz de Cede£o, Nelson Garcia, Manuel Gonzalez, Sixto J. Inchaustegui, Matilde Mota, Ramon O. Sanchez, Miguel Silva, Domingo A. Siri and Servio R. Sosa.

Lago Enriquillo (1)

Location: 18°28'N, 71°39'W; 60 km WNW of Barahona, Provinces of Bahoruco and Independencia.
Area: 26,500 ha.
Altitude: 46m below sea level.
Province and type: 8.40.13; 14, 16 & 17.
Site description: A large permanent hypersaline lake, 35 km long and up to 8m deep, in an old sea channel; the largest lake in the Antilles. The water is sulphuric; the salinity varies from 40 to 90 p.p.t.; and the level fluctuates in cycles of many years. There is one large island, Isla Cabritos, and several small islands. The lake is fed by seasonal streams, and there are areas of seasonally flooded marshes, wet grassland and irrigated cultivation along the shore.
Principal vegetation: Marshes with *Typha sp, Pistia stratiotes* and *Nasturtium officinale.* In the subtropical dry forest and subtropical thorn woodland zones, with *Prosopis juliflora, Neoabbottia paniculata, Uniola virgata, Phyllostylon brasiliensis* and *Bursera simaruba.*
Land tenure: State owned.
Protection: Isla Cabritos is a National Park of 2,600 ha, established in 1974; the lake itself and its surrounding marshes are unprotected.
Land use: Fishing and waterfowl hunting. Agriculture, livestock grazing and wood-cutting for charcoal production in surrounding areas.
Waterfowl: A very important area for breeding, passage and wintering waterfowl of a wide variety of species, and one of the most important localities in Hispaniola for the Caribbean Flamingo *Phoenicopterus ruber.* Flamingos may have nested regularly in the 19th century, but the only reports of breeding in recent decades were in 1975 and 1977 when colonies of 20-30 pairs were located. Up to several hundred birds are regular as non-breeding visitors, and 500-600 were recorded in January 1978. Other common species include *Ixobrychus exilis, Nycticorax nycticorax, Nyctanassa violacea, Butorides virescens, Egretta caerulea, E. tricolor, E. rufescens, E. thula, E. alba, Ardea herodias, Eudocimus albus* (breeding), *Plegadis falcinellus* (breeding), *Ajaia ajaja, Anas bahamensis, Gallinula chloropus, Himantopus himantopus* (breeding) and *Sterna albifrons.* Common Nearctic migrants include *Anas discors*, a wide variety of shorebirds, *Larus atricilla, Hydroprogne caspia* and *Sterna hirundo.*
Other fauna: The lake supports an important population of the American Crocodile *Crocodylus acutus*, recently estimated at between 175 and 250 individuals. The iguanas *Cyclura cornuta cornuta* and *C. ricordii* occur around the lake and on Isla Cabritos. The introduced *Tilapia mossambica* supports a small local fishery.
Threats: Freshwater streams in the surrounding hills and subterranean waters have been diverted for irrigation, reducing the inflow into the lake and resulting in a gradual falling in level. The marshes are being converted into pasture and agricultural land, and the surrounding forests are being destroyed for charcoal. There is indiscriminate hunting of waterfowl, and some crocodiles are shot for "sport", as curios, or for "medicinal" oils.
Research and conservation: A number of faunal and floral investigations have been carried out at the lake, and a major study of the *Crocodylus acutus* population is currently in progress. Lago Enriquillo is of great scientific interest as a fossil marine ecosystem and should be protected from any further degradation.
References: Bonnelly de Calventi (1978 & 1980); Wiley & Wiley (1979); Bonnelly de Calventi & Garcia de Geralde (1980); Pe£a Franjul *et al* (1980).
Source: Idelisa Bonnelly de Calventi, Maria E. Feliz de Cede£o, Nelson Garcia, Sixto J. Inchaustegui and Domingo A. Siri.
Criteria for inclusion: 123.

Laguna Limon (2)

Location: 18°24'N, 71°43'W; south of Lago Enriquillo, 17 km ESE of Jimani, Independencia Province.
Area: Several hundred ha.
Altitude: 10m.
Province and type: 8.40.13; 08 & 12.
Site description: A permanent freshwater lake, up to 2m deep, with some mangroves and abundant aquatic vegetation. The lake was partially drained for agriculture in the early 1970s.
Principal vegetation: Mangroves *Conocarpus erectus.*
Land tenure: State owned.
Protection: None.
Land use: Fishing, hunting and exploitation of wood for charcoal.
Waterfowl: An important area for resident and migratory waterfowl, with one of the largest populations of *Fulica caribaea* in the Dominican Republic. Other residents include *Podilymbus podiceps* and *Oxyura jamaicensis.* A variety of Anatidae occur on migration, the commonest being *Anas discors.* Formerly an important feeding area for *Phoenicopterus ruber*, but none have been recorded since the drainage in the early 1970s.
Other fauna: No information.
Threats: Disturbance from hunting and fishing.
Source: Manuel Gonzalez.
Criteria for inclusion: 3a.

Laguna Bermesi (3)

Location: 18°18'N, 71°27'W; 3-4 km west of Angostura, Independencia Province.
Area: 125 ha.
Altitude: 0m.
Province and type: 8.40.13; 08 & 12.
Site description: A permanent freshwater lake, up to 1m deep, with associated marshes and some mangroves. The level of the lake fluctuates according to local rainfall.
Principal vegetation: Marshes with *Typha domingensis*, and mangroves *Conocarpus erectus.* Surrounded by natural pastures and xerophytic woodland.
Land tenure: No information.
Protection: None, but the lake is difficult of access and little disturbed.
Land use: Some hunting; cattle ranching, agriculture and exploitation of wood for charcoal in surrounding areas.
Waterfowl: An important area for resident and migratory waterfowl, with a large population of *Fulica caribaea.* Large numbers of Anatidae, principally *Anas discors*, and shorebirds occur on migration.
Other fauna: No information.
Threats: Diversion of water for irrigation and overgrazing by domestic livestock are the principal threats.
Source: Manuel Gonzalez.
Criteria for inclusion: 3a.

Laguna de Rincon (Laguna de Cabral) (4)

Location: 18°17'N, 71°15'W; 1 km north of Cabral, Barahona Province.
Area: 3,000 ha.
Altitude: 141m.
Province and type: 8.40.13; 08, 12 & 16.
Site description: A permanent fresh to brackish lake, up to 6m deep, with associated marshes, some mangroves and surrounding seasonally flooded grassy plains. The lake is fed by the Rio Yaque del Sur and several smaller streams. There is a small seasonal freshwater lake (Laguneta Seca) 0.5 km to the north.

Principal vegetation: Marshes with *Typha domingensis, Potamogeton nodosus, Sagittaria lancifolia, Arundo donax, Nelumbo lutea, Nymphaea ampla* and *Ceratophyllum demersum*; mangroves *Conocarpus erectus*. In the dry subtropical forest zone.
Land tenure: State owned.
Protection: Laguna de Rincon was declared a Scientific Reserve in August 1983, but no special protection measures have been implemented, pending a study of the social problems which may arise. Laguneta Seca is unprotected, but there is a proposal to include the lake within the limits of the Scientific Reserve.
Land use: Intensive fishing for various species of fishes, freshwater shrimps and turtles, and waterfowl hunting; cattle ranching, agriculture and exploitation of wood for charcoal in surrounding areas.
Waterfowl: An important area for a wide variety of resident, passage and wintering waterfowl. Resident species include *Podiceps dominicus, Egretta caerulea, Ardea herodias, Gallinula chloropus, Porphyrula martinica, Fulica americana* and *Jacana spinosa.* Common passage migrants and non-breeding visitors include *Plegadis falcinellus, Phoenicopterus ruber* (up to 155 in recent years), *Anas discors, A. acuta, A. clypeata, Aythya affinis* (up to 1,000), many shorebirds, and *Hydroprogne caspia.* Over 1,000 *Tringa flavipes* were present in March 1984.
Other fauna: *Pandion haliaetus* is a regular winter visitor. The lake is the principal locality and centre of distribution of the endemic freshwater turtle *Chrysemys decorata.*
Threats: The marshes are being drained for agriculture, and the mangroves uprooted and burned. The Government plans to divert the main river entering the lake for agricultural projects nearby. Intensive fishing and indiscriminate hunting cause a considerable amount of disturbance.
Research and conservation: A considerable amount of research has been conducted on the fauna and flora of the lake. Although declared a Scientific Reserve in 1983, the diversion of water supplies and destruction of mangroves continues, and unless some action is taken in the very near future, much of the lake ecosystem will be destroyed and the locally important fishery lost.
References: Inchaustegui (1978 & 1983); Wiley & Wiley (1979); Bonnelly de Calventi (1980); Departamento de Vida Silvestre (1980a); Bolay *et al* (1983); Salcedo *et al* (1983).
Source: Geraldino Caminero, Nelson Garcia, Manuel Gonzalez and Sixto J. Inchaustegui.
Criteria for inclusion: 1c, 2b & 3a.

Laguna de Oviedo (5)

Location: 17°46'N, 71°21'W; near Oviedo, Pedernales Province.
Area: 2,488 ha.
Altitude: 0m.
Province and type: 8.40.13; 05, 07 & 08.
Site description: A permanent highly saline coastal lagoon, up to 9m deep, with muddy shores, mangrove swamps and several small islands; separated from the sea by a belt of sand dunes 200-400m wide. The lagoon has no direct connection with the sea except during storms. The water level fluctuates considerably according to local rainfall.
Principal vegetation: Beds of *Ruppia maritima*; mangrove swamps with *Conocarpus erectus*; some brackish marshes with *Typha* sp. In the subtropical dry forest zone, with *Prosopis* sp and various cacti.
Land tenure: State owned.
Protection: Within the Jaragua National Park, established in 1983 but not as yet fully implemented.
Land use: Fishing, waterfowl hunting, and extraction of salt; uncontrolled livestock grazing and agriculture in surrounding areas.
Waterfowl: An important area for breeding, passage and wintering waterfowl. Breeding species include *Podilymbus podiceps, Pelecanus occidentalis, Egretta rufescens* and *Eudocimus albus.* Many Nearctic Anatidae and shorebirds occur on migration and in winter, and *Phoenicopterus ruber* is a regular visitor in small numbers.
Other fauna: *Pandion haliaetus* is a winter visitor. The freshwater turtle *Chrysemys decorata* occurs in the streams entering the lagoon, and the iguana *Cyclura cornuta* occurs on the islands.

Threats: Part of the lagoon has been converted into salt pans for salt extraction; there is indiscriminate hunting of waterfowl, particularly Anatidae; and there were plans to use areas around the lagoon for the disposal of domestic sewage.
Research and conservation: The fauna and flora of the lagoon are poorly known, and clearly merit further study.
References: Departamento de Vida Silvestre (1983).
Source: Venecia Alvarez, Jurgen Czerwenka and Sixto J. Inchaustegui.
Criteria for inclusion: 2b & 3a.

Laguna Salada (Laguna de Bucan de Base) (6)

Location: 17°41'N, 71°28'W; 15 km SSW of Oviedo, Pedernales Province.
Area: 200 ha.
Altitude: 0m.
Province and type: 8.40.13; 07 & 08.
Site description: A permanent brackish coastal lagoon, up to 2m deep, with some brackish marshes and mangrove swamp. The water level fluctuates seasonally according to local rainfall.
Principal vegetation: Mangroves and brackish marshes; in a region of xerophytic and halophytic plant communities.
Land tenure: State owned.
Protection: Within the Jaragua National Park, established in 1983 but not as yet fully implemented.
Land use: Occasional hunting and fishing; the area is practically undisturbed by man.
Waterfowl: A very important area for resident and migratory waterfowl. Breeding species include *Nyctanassa violacea, Egretta tricolor, E. rufescens, Eudocimus albus, Plegadis falcinellus, Gallinula chloropus, Charadrius wilsonius, Catoptrophorus semipalmatus* and *Himantopus himantopus.* Up to 440 *Phoenicopterus ruber* have been recorded in recent years, and the species has nested (three small colonies totalling 77 pairs were located in January 1978). *Pelecanus occidentalis* is common year round, and *Anas discors* and a variety of shorebirds are common on passage and in winter.
Other fauna: No information.
Threats: There is some disturbance from fishing activities.
Research and conservation: The avifauna has been studied by Pe£a Franjul.
References: Pe£a Franjul (1978a); Wiley & Wiley (1979); Departamento de Vida Silvestre (1983).
Source: Sixto J. Inchaustegui and Ramon O. Sanchez.
Criteria for inclusion: 1b & 3a.

Laguna de Puerto Viejo (7)

Location: 18°21'N, 70°51'W; 15 km southwest of Puerto Viejo, Azua Province.
Area: 694 ha.
Altitude: 0m.
Province and type: 8.40.13; 01, 03 & 08.
Site description: A shallow sea bay with six small islands (Islas de Barrera), mangrove swamps and coral reefs.
Principal vegetation: Mangrove swamps; dry subtropical forest with *Prosopis* sp and various cacti on the adjacent mainland.
Land tenure: A mixture of state and private ownership.
Protection: None.
Land use: Fishing and wood-cutting.
Waterfowl: The islands are important for breeding *Pelecanus occidentalis* and six species of Ardeidae, and the bay is important for passage and wintering shorebirds and Laridae.
Other fauna: An important area for the manatee *Trichechus manatus.* The rich marine fauna includes the crustaceans *Panulirus argus* and *Callinectes* sp, and the molluscs *Strombus gigas* and *Crassostrea rhizophorae.*

Threats: Overfishing. The bay has suffered some modification as a result of an irrigation scheme on the adjacent mainland.
References: Gonzalez *et al* (1978).
Source: Venecia Alvarez and Matilde Mota.
Criteria for inclusion: 2a, 2c & 3a.

Laguna de Don Gregorio and Laguna de Los Reyes (8)

Location: 18°15'N, 70°15'W; 45 km southwest of Santo Domingo, Peravia Province.
Area: 20 ha & 6 ha respectively.
Altitude: 5m.
Province and type: 8.40.13; 12 & 17.
Site description: Two permanent freshwater lakes, up to 6m deep, and associated marshes with rice-growing areas, near the Rio Nizao.
Principal vegetation: Marshes with *Typha domingensis*, *Eleocharis* sp, *Neptunia oleracea*, *Ludwigia* sp and *Ceratophyllum* sp; and rice-fields.
Land tenure: A mixture of state and private ownership.
Protection: None.
Land use: Fishing, hunting of waterfowl and freshwater turtles, rice cultivation, and a little sheep grazing.
Waterfowl: The lakes support a small population of resident waterfowl and some Nearctic Anatidae occur on migration.
Other fauna: The two lakes are the only known locality for a small and heavily exploited population of freshwater turtles with characters intermediate between *Chrysemys decussata vicina* and *C. decorata*. The Medicinal Leech *Hirudo medicinalis* occurs.
Threats: Drainage of the marshes for rice cultivation, and indiscriminate hunting and fishing.
References: Inchaustegui (1975).
Source: Julio Cicero and Sixto J. Inchaustegui.
Criteria for inclusion: 2b & 3a.

Estuaries of the Rio Higuamo and Rio Soco (9)

Location: 18°27'N, 69°15'W; near San Pedro de Macoris, San Pedro de Macoris Province.
Area: Several hundred ha.
Altitude: 0m.
Province and type: 8.40.13; 02, 08, 09 & 11.
Site description: Riverine marshes along the lower courses of the Higuamo and Soco Rivers, and mangrove swamps at the river mouths.
Principal vegetation: Mangrove swamps and a great variety of riverine vegetation.
Land tenure: Public ownership.
Protection: None.
Land use: Exploitation of mangroves.
Waterfowl: Known to be important for a variety of waterfowl, particularly Ardeidae, but little information is available.
Other fauna: The crab *Cardisoma guanhumi* is common.
Threats: The construction of a dam on the Rio Soco has modified the vegetation along that river, and the mangroves are being overexploited.
Source: Venecia Alvarez.
Criteria for inclusion: 0.

Wetlands in Parque Nacional del Este (10)

Location: 18°15'N, 68°45'W; southeast of La Romana, Altagracia Province.
Area: Unknown.
Altitude: 0m.
Province and type: 8.40.13; 03, 04, 05, 07 & 08.
Site description: Sea coasts with rocky shores and sandy beaches around the island of Saona and on the adjacent mainland, and mangrove swamps, particularly on the mainland coast. There are four small saline lagoons on Saona Island: Laguna Los Flamencos, Laguna Canto de la Playa, Laguna Tortuga and Laguna El Cuerno.
Principal vegetation: Mangrove swamps with *Avicennia germinans*, *Laguncularia racemosa*, *Conocarpus erectus* and *Rhizophora mangle*; beaches with the coconut palm *Cocos nucifera*. In a region of subtropical dry forest and subtropical moist forest.
Land tenure: State owned.
Protection: Included within the Parque Nacional del Este (43,400 ha) established in 1975.
Land use: Fishing, particularly for lobsters and conch, also hunting and tourism. There is some slash-and-burn agriculture in the Park.
Waterfowl: Little information is available, but *Phoenicopterus ruber* is known to occur asan occasional visitor.
Other fauna: The manatee *Trichechus manatus* is an occasional visitor, and the sea turtle *Dermochelys coriacea* nests on the beaches. There are some coral reefs in inshore waters.
Threats: Overfishing of lobsters and conch, and hunting of manatees.
Research and conservation: Some studies have been carried out on the birds and reptiles of the Park, and a management plan has been prepared.
References: IUCN (1982).
Source: See references.
Criteria for inclusion: 3a.

Laguna Limon (11)

Location: 18°58'N, 68°51'W; 20 km east of Miches, El Seibo Province.
Area: 488 ha.
Altitude: 5m.
Province and type: 8.40.13; 05, 08 & 12.
Site description: A permanent freshwater lake, up to 1.4m deep, fringing marshes and some mangrove swamps; separated from the sea by a sand barrier, and fed by several arroyos. There is very little fluctuation in water level.
Principal vegetation: Mangrove swamps with *Rhizophora mangle*; beaches with the coconut palm *Cocos nucifera*; and relict stands of *Pterocarpus officinalis*, a species now on the verge of extinction in the region.
Land tenure: A mixture of state and private ownership.
Protection: Recently included within a Scientific Reserve (Reserva Cientifica Natural), but this has not as yet been fully implemented.
Land use: Fishing; there is also some rice cultivation, harvesting of coconuts, cattle ranching and hunting in the area.
Waterfowl: Known to be an important area for resident and migratory waterfowl, but no details are available.
Other fauna: The lake supports an important population of the freshwater turtle *Chrysemys decussata vicina*.
Threats: The aquatic fauna is not under immediate threat; however, there is a potential threat from the expansion of rice-growing in the area, and there is considerable disturbance from hunting. Deforestation is a problem throughout the region.
Research and conservation: Some studies have been carried out on the fauna and flora of the lake.
References: Direccion Nacional de Parques (1980); INDOTEC (1980); Alvarez & Bonnelly de Calventi (1983); Mejia & Gonzalez (undated).
Source: Sixto J. Inchaustegui and Servio R. Sosa.
Criteria for inclusion: 1c, 2b & 3a.

Laguna Redonda (12)

Location: 19°01'N, 68°57'W; 10 km ENE of Miches, El Seibo Province.
Area: 700 ha.
Altitude: 0m.
Province and type: 8.40.13; 05, 07 & 08.
Site description: A permanent brackish coastal lagoon, up to 2m deep, with fresh to brackish marshes, some mangrove swamps, and a narrow connection with the sea. There are slight fluctuations in water level according to the tides.
Principal vegetation: Mangrove swamps with *Laguncularia racemosa, Conocarpus erectus* and *Rhizophora mangle*; marshes with *Typha domingensis*; coconut palms *Cocos nucifera*; and some *Pterocarpus officinalis.*
Land tenure: A mixture of state and private ownership.
Protection: Recently included within a Scientific Reserve (Reserva Cientifica Natural), but this has not as yet been fully implemented.
Land use: Fishing; there is some rice cultivation, cattle ranching and hunting in surrounding areas.
Waterfowl: Known to be an important area for resident and migratory waterfowl but no details are available.
Other fauna: The lagoon supports an important population of the freshwater turtle *Chrysemys decussata vicina.*
Threats: The intensive cultivation of rice poses a threat to the wetland habitat, and there is uncontrolled grazing of domestic livestock and excessive disturbance from hunting.
Research and conservation: Some studies have been carried out on the fauna and flora of the lagoon.
References: INDOTEC (1980); Alvarez & Bonnelly de Calventi (1983).
Source: Sixto J. Inchaustegui and Servio R. Sosa.
Criteria for inclusion: 1c, 2b & 3a.

Estuaries of the Rio Yuna and Rio Barracote (13)

Location: 19°10'N, 69°38'W; on the Bahia de Samana, south of Sanchez, Samana Province.
Area: Several thousand ha.
Altitude: 0m.
Province and type: 8.40.13; 02 & 08.
Site description: The estuaries of the Yuna and Barracote Rivers, with extensive mangrove swamps.
Principal vegetation: Mangrove swamps.
Land tenure: Under public ownership.
Protection: None.
Land use: Exploitation of mangroves.
Waterfowl: No information.
Other fauna: The locally endangered oyster *Crassostrea rhizophorae* occurs in the mangroves.
Threats: Exploitation of the mangroves for the construction of buildings for the tobacco industry has greatly reduced the extent of mangrove swamp, and caused serious erosion.
Source: Venecia Alvarez.
Criteria for inclusion: 0.

Laguna de Saladilla (14)

Location: 19°39'N, 71°43'W; 6 km southeast of Pepillo Salcedo, Monte Cristi Province.
Area: 2,000 ha.
Altitude: 0m.
Province and type: 8.40.13; 05, 08 & 12.

Site description: A permanent shallow fresh to brackish lake and marshes with some mangroves; separated from the sea by a belt of coastal sand dunes. The salinity is variable, and the water level fluctuates according to flooding in the nearby river.
Principal vegetation: Mangroves with *Rhizophora mangle*; marshes with *Typha domingensis, Pistia stratiotes, Eichhornia* sp, *Ceratophyllum* sp and *Lemna* sp.
Land tenure: State owned.
Protection: None.
Land use: Fishing, and hunting of waterfowl and freshwater turtles. Agriculture in surrounding areas.
Waterfowl: An extremely rich area for waterfowl, with a wide variety of breeding, passage and wintering species. Residents include *Podilymbus podiceps, Butorides virescens, Egretta tricolor, Ardea herodias, Dendrocygna arborea, Gallinula chloropus, Porphyrula martinica, Fulica americana* and *Jacana spinosa.* Regular non-breeding visitors include *Pelecanus occidentalis, Phoenicopterus ruber* and *Anas bahamensis.* A variety of Nearctic ducks occur in winter; the most common are *Anas americana, A. discors, Aythya affinis* and *A. collaris*, but *Anasacuta, A. cyanoptera, A. clypeata, Aythya americana* and *Oxyura jamaicensis* also occur regularly.
Other fauna: *Pandion haliaetus* is a winter visitor. The American Crocodile *Crocodylus acutus* has been recorded on a number of occasions, and the freshwater turtle *Chrysemys decussata vicina* is common.
Threats: There is some pollution in the lagoon, and overfishing and excessive hunting are causing problems.
Research and conservation: Some faunal surveys have been conducted in the area, and the avifauna is relatively well known.
References: Pe£a Franjul (1977); OEA (1977); Wiley & Wiley (1979).
Source: Sixto J. Inchaustegui and Miguel Silva.
Criteria for inclusion: 2a, 2b & 3a.

Cayos Siete Hermanos (15)

Location: 19°51'N, 71°49'W; in the Caribbean, 12-25 km west of Monte Cristi, Monte Cristi Province.
Area: Several hundred ha.
Altitude: 0m.
Province and type: 8.40.13; 01, 03, 05 & 08.
Site description: A group of seven small sandy islands with some mangrove swamps.
Principal vegetation: Mangroves; low scrub with *Batis* sp, *Sesuvium* sp and some cacti; marine vegetation including species of *Penicillus, Dictyota* and *Sargassum.*
Land tenure: Under public ownership.
Protection: Included within a Scientific Reserve established in 1983.
Land use: Exploitation of birds' eggs and molluscs.
Waterfowl: No information.
Other fauna: There are large breeding colonies of the terns *Sterna fuscata* and *Anous stolidus*, and significant numbers of the manatee *Trichechus manatus.*
Threats: The tern colonies and mollusc populations are being overexploited, and the terrestrial vegetation has been disturbed by egg-collectors.
Research and conservation: Further studies are required to determine the full importance of the islands. It has been recommended that the Monte Chico and Ratas Cays be maintained as Scientific Reserves, and that the other islands be made into a National Park.
References: Alvarez (1980).
Source: Venecia Alvarez.
Criteria for inclusion: 2a, 2b & 3a.

FRENCH ANTILLES

INTRODUCTION

based on information provided by Edouard Benito-Espinal of the Delegation Regionale a l'Architecture et a l'Environnement, Ministere de l'Environnement et du Cadre de Vie.

The French Antilles form two Overseas Departments of France; one comprises Martinique, and the other comprises Guadeloupe, its offshore islands Marie-Galante, Les Saintes and La Desirade, and two more distant islands, Saint-Barthelemy and the French part of Saint-Martin. Martinique, Guadeloupe and its offshore islands lie in the northern Windward Islands, Saint-Barthelemy and Saint-Martin in the northern Leewards. As Departments of France, the islands have the same political status as any Department in European France. Martinique is 1,100 sq. km in extent and has a population of about 400,000; the Department of Guadeloupe is 1,790 sq. km in extent (Guadeloupe 1,510 sq. km, Marie-Galante 153 sq. km, Saint-Martin 54 sq. km and Saint-Barthelemy 21 sq. km) and has a population of about 330,000. The economy is based on agriculture, particularly sugar, bananas and pineapples, and to an increasing extent on tourism.

Martinique and the western part of Guadeloupe (Basse-Terre) are mountainous and volcanic, rising to peaks of 1,397m and 1,484m respectively. High rainfall in the interior supports luxuriant tropical rain and cloud forest. The eastern part of Guadeloupe (Grande-Terre) and the other islands are low-lying limestone islands with dry woodland and cactus scrub. The climate throughout the islands is tropical with mean annual temperatures of around 26°C, and a fairly well defined dry season in the winter months. The average annual rainfall varies greatly from 800-1,500 mm on the smaller islands and Grande-Terre to over 7,500 mm in the highlands of Basse-Terre and Martinique.

In both Guadeloupe and Martinique there are important wetlands, mainly mangrove swamps and saline lagoons. The mangrove swamps of mainland Guadeloupe (9,668 ha) and Martinique (2,200 ha) include the largest tracts of mangroves in the Lesser Antilles, while the many lagoons on Saint-Martin and Saint-Barthelemy include the Grand Etang de Simsonbaai (1,250 ha), the largest saline lagoon in the Lesser Antilles. There are, however, no wetlands of any significance on La Desirade or Les Saintes islands.

A wide variety of waterfowl occur on passage and in winter, particularly Ardeidae, Anatidae and migratory shorebirds, but few species breed and only *Bubulcus ibis* is common (with a population of about 6,000 birds on mainland Guadeloupe alone). Hunting pressure is heavy on Martinique, Guadeloupe, Marie-Galante and Saint-Martin, and is thought to be at least partly responsible for the paucity of breeding birds.

Institutional Base for Wetland Conservation and Research

The principal governmental bodies concerned with environmental conservation are:

Direction de la Protection de la Nature, Ministere de la Qualite de la Vie; responsible for the establishment of parks and reserves, and setting the hunting regulations.

Delegation Regionale a l'Architecture et a l'Environnement, Ministere de l'Environnement et du Cadre de Vie. This conducts research on the fauna and flora of the islands.

Office National des Forets (ONF); responsible for the administration of parks and reserves. The ONF has conducted some research on mangroves.

Institut Scientifique et Technique des Peches Maritimes (ISTPM). This conducts studies on marine resources and aquaculture.

Institut National de la Recherche Agronomique (INRA). Research includes studies of fauna and flora, and water pollution.

The principal non-governmental bodies concerned directly with nature conservation are the

Union Regionale des Associations du Patrimonie et de l'Environnement en Guadeloupe (URAPEG), an association of all nature conservation groups in Guadeloupe, and the Union Regionale des Associations de Protection de l'Environnement a la Martinique (URAPEM). The latter is an association of five conservation groups in Martinique, the Societe pour l'Etude de la Protection et l'Amenagement de la Nature en Martinique (SEPANMAR), the Societe des Amis du Parc, the Alliance Nature et Developpement, the Association pour Nature et Environnement (APNE) and ASSAUPAMAR. SEPANMAR is a regional branch of SEPANRIT based in Bordeaux, France.

The University of the French Antilles and French Guiana (Centre Universitaire Antilles-Guyane) is very active in conservation related fields, and has conducted research on fauna and flora, marine resources and pollution.

Progress in Wetland Conservation and Research

As Departments of France, Guadeloupe and Martinique have the same legislation as that country. This includes the law of July 1960 which applies to the establishment of national parks, and the law of July 1976 which applies to all aspects of conservation, including reserves. No wetland reserves have as yet been created in the Department of Guadeloupe, but a reserve of 4,700 ha is currently being implemented in the Grand Cul-de-Sac Marin. This reserve, which will comprise a part of the Parc National de la Guadeloupe, will incorporate extensive mangrove swamps, coral reef formations, sea-grass beds and the offshore island of Fajou. Other areas proposed for protection include the Pointe des Chateaux lagoons in southeast Guadeloupe and the Marais de Folle Anse in western Marie-Galante. In Martinique, there is one managed nature reserve of 517 ha, the Reserve Naturelle de La Caravelle, which incorporates several small sea bays with mangroves and littoral vegetation. In addition, there are three "reserves maritimes de chasse" containing important wetland habitat; Baie de Fort-de-France (250 ha), Etang des Salines (90 ha) and Baie des Anglais (60 ha). All were established in 1976. Hunting is prohibited by law, but enforcement is reported to be poor.

Hunting legislation dates from 1953, when the legislation of Metropolitan France was extended to cover Guadeloupe and Martinique. The hunting regulations are revised each year by the Direction de la Protection de la Nature in the Ministere de la Qualite de la Vie. In recent years, all waterfowl have been protected except for the commoner Anatidae and larger shorebirds, which may be hunted on certain days of the week between mid July and the end of February on Martinique, Guadeloupe, Marie-Galante and Saint-Martin.

Almost all of the research conducted to date on wetlands in the French Antilles has focussed on mangrove ecosystems and pollution problems. Most important has been a recent multidisciplinary study of mangroves throughout the islands coordinated by Jacques Portecop at the Centre Universitaire Antilles-Guyane. Other relevant research has included a detailed review of hunting in the Department of Guadeloupe by Benito-Espinal (1982) and a study of the flora and avifauna of islands in the Grand Cul-de-Sac Marin by Portecop & Benito-Espinal (1984b).

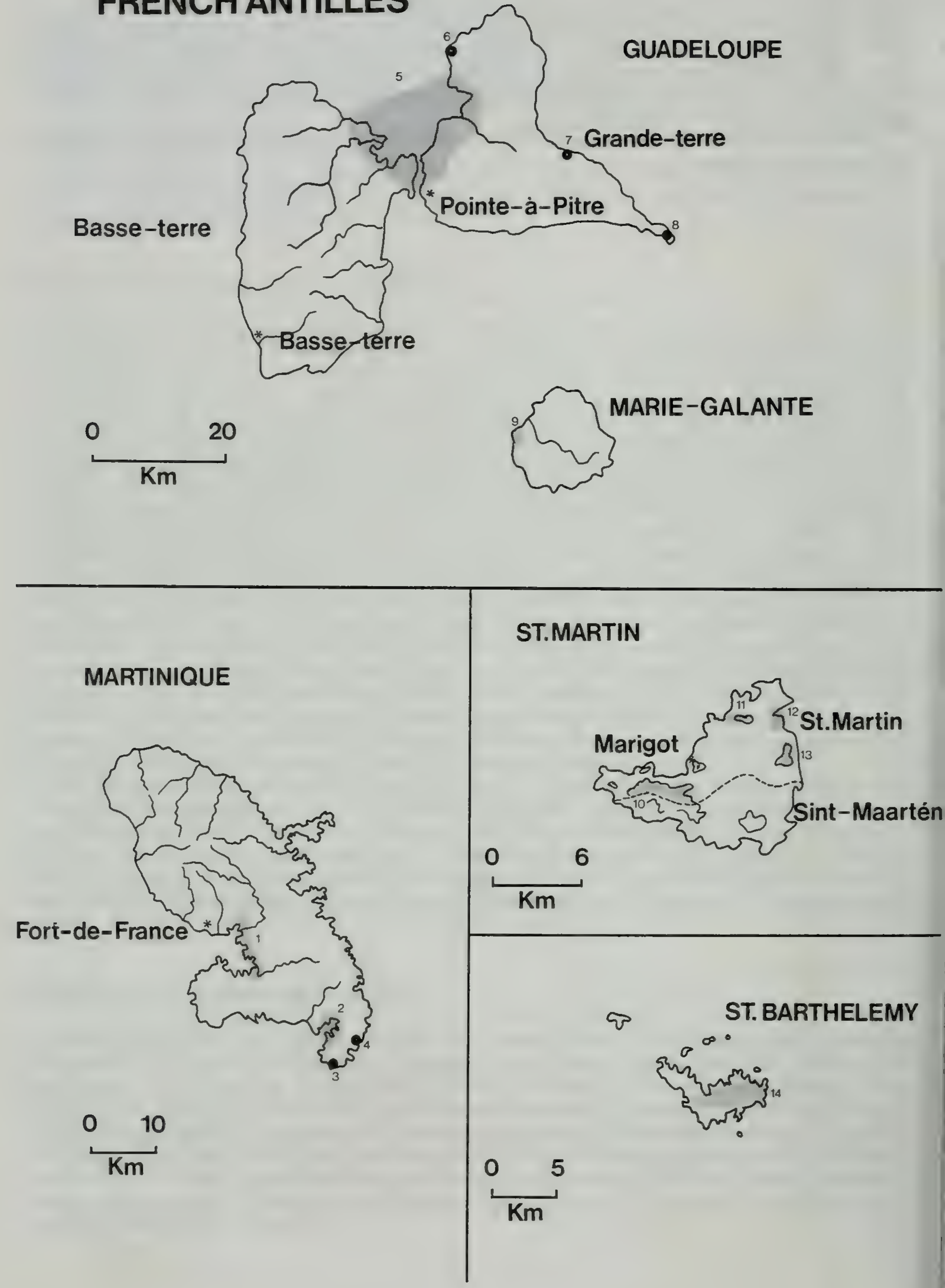
Major Threats to Wetlands and Waterfowl

Wetlands throughout the French Antilles are under threat from urban and industrial development, the construction of roads, airports, tourist hotels and marinas, and drainage for agriculture. The situation is particularly severe on Saint-Martin, where numerous hotel projects have seriously disturbed the saline lagoon ecosystems. Mangroves are being affected by seaborne oil pollution, and there is widespread pollution from domestic sewage, industrial waste (including heavy metals) and pesticide run-off. Some wetlands are being used as rubbish dumps, and in several areas sand mining is having a detrimental effect on nearby mangrove and marine ecosystems. Mangroves are also destroyed by hunters to provide open water areas attractive to migratory shorebirds.

Hunting poses a serious threat to waterfowl populations on the main islands. There are at least twenty-four hunting clubs in the hunting federations (Federations Departementales des Chasseurs) in Martinique and Guadeloupe, over 4,200 licensed hunters, and perhaps as many as 4,000 illegal hunters. Although only a small number of species of waterfowl are legitimate game, the regulations are often ignored and many protected species are shot. Heavy hunting pressure at the start of the open season in July is particularly harmful to resident waterfowl which are still breeding at that time.

Other significant threats to breeding waterfowl include illegal egg-collecting and predation by introduced predators.

FRENCH ANTILLES


GUADELOUPE
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Fort-de-France
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St. Martin
Marigot
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Sint-Maartén
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WETLANDS

Site descriptions based on information provided by Edouard Benito-Espinal of the Ministere de l'Environnement et du Cadre de Vie, and Jacques Portecop of the Centre Universitaire Antilles-Guyane.

Baie de Fort-de-France (1)

Location: 14°34'N, 61°01'W; southeast of Fort-de-France and west of Lamentin, Martinique.
Area: 2,200 ha.
Altitude: 0m.
Province and type: 8.41.13; 01 & 08.
Site description: Extensive mangrove swamps and associated brackish to saline marshes, including the Marais du Lamentin and Marais de Riviere Salee; bordering a shallow sea bay.
Principal vegetation: Mangroves; sea-grass beds in the southern part of the bay and cultivation inland.
Land tenure: Mainly privately owned.
Protection: No habitat protection; 250 ha in the southeast are included within a Reserve de Chasse Maritime (established in 1976), in which hunting is prohibited.
Land use: Solid waste diposal in the south; extensive cultivation and urban and industrial development nearby.
Waterfowl: An important area for a wide variety of waterfowl. Breeding species include *Nyctanassa violacea, Bubulcus ibis, Butorides virescens, Oxyura dominica, Gallinula chloropus* and probably *Egretta caerulea, E. thula* and *E. alba.* Passage migrants and winter visitors include *Nycticorax nycticorax, Egretta tricolor, Ardea herodias, Dendrocygna bicolor, Anas americana, A. discors, A. clypeata, Aythya affinis, Himantopus himantopus* and eighteen species of Nearctic shorebirds.
Other fauna: *Pandion haliaetus* is a regular passage migrant.
Threats: There is a considerable amount of industrial and domestic pollution, and heavy hunting pressure during the hunting season.
Research and conservation: Identified by Putney as one of the largest remaining contiguous areas of relatively unspoiled mangroves in the Lesser Antilles and an area with multiple resource values. The greater part of the area has been proposed for protection. Enforcement of the existing Reserve de Chasse Maritime is reported to be poor.
References: Putney (1982).
Source: Edouard Benito-Espinal.
Criteria for inclusion: 3a.

Marais de Sainte Anne (2)

Location: 14°28'N, 60°52'W; north of Sainte Anne, near the southern tip of Martinique.
Area: c.250 ha.
Altitude: 0m.
Province and type: 8.41.13; 01 & 08.
Site description: Mangrove swamps bordering a shallow sea bay.
Principal vegetation: Mangroves.
Land tenure: Mainly privately owned.
Protection: None.
Land use: Cultivation and some urban and tourist development in surrounding areas.
Waterfowl: No information.
Other fauna: No information.
Threats: Domestic pollution.
References: Putney (1982).
Source: Edouard Benito-Espinal.
Criteria for inclusion: 0.

Etang des Salines (3)

Location: 14°24'N, 60°53'W; SSE of Sainte Anne, at the southern tip of Martinique.
Area: 240 ha.
Altitude: Near sea level.
Province and type: 8.41.13; 07 & 08.
Site description: A large saline lagoon and several small saline ponds with extensive fringing mangrove swamps and brackish to saline marshes.
Principal vegetation: Mangroves and brackish to saline marshes; dry woodland in surrounding areas.
Land tenure: A mixture of public and private ownership.
Protection: No habitat protection; the principal lagoon is included in a Reserve de Chasse Maritime (90 ha, established in 1976), in which hunting is prohibited.
Land use: None.
Waterfowl: Breeding species include *Butorides virescens*, *Oxyura dominica* and *Gallinula chloropus*; passage migrants and winter visitors include *Egretta caerulea*, *E. thula*, *E. alba*, *Ardea herodias*, *Dendrocygna bicolor*, *Anas americana*, *A. discors*, *Porzana carolina* and a variety of shorebirds.
Other fauna: *Pandion haliaetus* is a regular passage migrant.
Threats: Illegal hunting.
Research and conservation: Identified by Putney as one of the largest remaining relatively unspoiled saline lagoons in the Lesser Antilles. With the Baie des Anglais (site 4), an area with multiple resource values. The prohibition on hunting is reported to be poorly enforced.
References: Putney (1982).
Source: Edouard Benito-Espinal.
Criteria for inclusion: 3a.

Baie des Anglais (4)

Location: 14°25'N, 60°51'W; southeast of Sainte Anne, near the southern tip of Martinique.
Area: c.120 ha.
Altitude: 0m.
Province and type: 8.41.13; 01, 05 & 08.
Site description: Mangroves and associated marshes around a sea bay, with sandy beaches in the south.
Principal vegetation: Mangroves and brackish to saline marshes.
Land tenure: Mainly privately owned.
Protection: No habitat protection; 60 ha are included in a Reserve de Chasse Maritime (established in 1976), in which hunting is prohibited.
Land use: Cultivation in surrounding areas.
Waterfowl: Breeding species include *Butorides virescens*, *Oxyura dominica* and *Gallinula chloropus*; passage migrants and winter visitors include *Egretta caerulea*, *Ardea herodias*, *Anas americana*, *A. discors*, *Porzana carolina* and a variety of shorebirds.
Other fauna: The sea turtle *Eretmochelys imbricata* nests on the beaches and there is a sea-bird colony on a small offshore islet.
Threats: Illegal hunting.
Research and conservation: This area and the Etang des Salines (site 3) have been identified by Putney as an area with multiple resource values. The prohibition on hunting is reported to be poorly enforced.
References: Putney (1982).
Source: Edouard Benito-Espinal.
Criteria for inclusion: 3a.

Grand Cul-de-Sac Marin (5)

Location: 16°20'N, 61°35'W; between northern Basse-Terre and northern Grande-Terre, Guadeloupe.
Area: c.7,000 ha (including 6,068 ha of mangroves).
Altitude: 0m.
Province and type: 8.41.13; 01, 03, 07, 08 & 18.
Site description: A large shallow sea bay with extensive mangrove swamps, brackish to saline coastal lagoons with associated marshes, and swampy *Pterocarpus* forest; between Port-Louis in the east and Sainte-Rose in the west. The bay and swamps connect with the Petit Cul-de-Sac Marin to the south via the Riviere Salee which separates Grande-Terre from Basse-Terre. The main mangrove swamps, from east to west, are the Petit Canal area, Marais des Jumeaux, Marais Monnerville, Marais Z'Herbe a Cecile, Marais Lambi, Riviere Salee and the delta of the Grande Riviere a Goyaves. There are several small islands with mangrove swamps in the bay, notably Ilet a Fajou and Ilet a Christophe.
Principal vegetation: Mangrove swamps with *Avicennia germinans, Laguncularia racemosa, Rhizophora mangle* and some *Conocarpus erectus*; swamp forest with *Pterocarpus officinalis*; and marshes with *Cladium jamaicensis, Sesuvium portulacastrum, Sporobolus virginicus, Eleocharis mutata, E. intersticta, Lippia nodiflora, Wedelia calicina, Ipomoea pescaprae, Pluchea odorata, Nephrolepis rivularis, Cyperus alopecuroides, Rhynchospora holochoenoides* and *Acrostichum aureum.* There are very extensive sea-grass beds offshore (6,700 ha), moist forests to the west, and dry woodland to the east.
Land tenure: Almost entirely public land (state owned).
Protection: None.
Land use: Hunting and fishing; agricultural land, and urban and industrial development inland.
Waterfowl: A very important area for breeding, passage and wintering waterfowl. Breeding species include *Podilymbus podiceps, Ixobrychus exilis, Nyctanassa violacea, Bubulcus ibis* (several thousands), *Butorides virescens, Egretta caerulea, E. thula, E. alba, Rallus longirostris manglecola, Gallinula chloropus, Porphyrula martinica, Fulica caribaea* and probably *Oxyura dominica.* The small islands in the bay are particularly important for nesting Ardeidae, and there is a very large breeding colony and roost of *B. ibis* on Ilet a Christophe. Regular passage migrants and winter visitors include *Egretta tricolor, Ardea herodias, Plegadis falcinellus, Dendrocygna bicolor, Anas americana, A. bahamensis, A. discors, Aythya affinis, Porzana carolina, Fulica americana*, about fifteen species of Nearctic shorebirds, *Larus atricilla* and several *Sterna spp. Pelecanus occidentalis* is a regular visitor in small numbers.
A sample of 639 waterfowl shot be seven hunters in the Petit Canal area in 1983 and 1984 included 416 *Catoptrophorus semipalmatus*, 56 *Limnodromus griseus*, 47 *Numenius phaeopus*, 42 *Tringa flavipes*, 21 *Tringa melanoleuca*, small numbers of nine other shorebirds, 18 *Anas discors* and 2 *Plegadis falcinellus.*
Other fauna: *Pandion haliaetus* and *Ceryle alcyon* occur on passage and in winter. The sea turtles *Chelonia mydas* and *Eretmochelys imbricata* nest on the islands and there are extensive coral reefs and important fishery resources in the bay.
Threats: The principal threat is continuing drainage and filling in of the swamps for agricultural land, urban expansion and industrial development. There is some pollution from domestic sewage and pesticides used on adjacent agricultural land, and heavy hunting pressure during the open season.
Research and conservation: A considerable amount of research has been conducted on the mangrove ecosystems, particularly at Ilet a Fajou, and the avifauna of the area is well known. The mangrove swamps comprise the largest remaining area of relatively unspoiled mangroves in the Lesser Antilles. Putney has identified the Petit Canal area as an area with multiple resource values, and the whole region as one of the priority areas for conservation in the Lesser Antilles. About 4,700 ha including the Lambi mangroves, Ilet a Fajou and extensive sea-grass beds are part of the proposed Parc National de la Guadeloupe.
References: IUCN (1982); Putney (1982); Portecop & Benito-Espinal (1984a & 1984b).
Source: Edouard Benito-Espinal and Jacques Portecop.
Criteria for inclusion: 123.

Pointe d'Antigues Marsh (6)

Location: 16°27'N, 61°32'W; north of Port-Louis, northwest Grande-Terre, Guadeloupe.
Area: 100 ha.
Altitude: 0-1m.
Province and type: 8.41.13; 05, 07 & 08.
Site description: Extensive fresh to brackish coastal marshes and adjacent mangrove swamps behind a sea beach. The marsh floods during the rainy season (July to December) and dries out almost completely during the dry season.
Principal vegetation: Mangrove swamps with *Avicennia germinans, Laguncularia racemosa* and *Conocarpus erectus*, and marshes with *Eleocharis mutata, Lippia nodiflora, Ipomoea pescaprae* and *Mariscus planifolius*; dry woodland and cactus scrub inland.
Land tenure: Public land (state owned).
Protection: None.
Land use: Hunting. Tourist recreation along the beach and cultivation in surrounding areas.
Waterfowl: A breeding area for *Ixobrychus exilis, Butorides virescens, Gallinula chloropus* and possibly *Egretta caerulea*, and an important feeding area for several other species of Ardeidae. Passage migrants and winter visitors include nine species of Anatidae, *Porzana carolina*, 19 species of migratory shorebirds and *Larus atricilla.* In a sample of 469 waterfowl of 21 species shot by hunters during August and September 1983 and 1984, the commonest species were *Tringa flavipes (39%), Pluvialis dominica (20%), Calidris melanotos (13%), Arenaria interpres (5%) and Limnodromus griseus (4%).*
Other fauna: *Pandion haliaetus* and *Ceryle alcyon* occur on passage and in winter.
Threats: Plans exist to drain the entire marsh for the construction of a coal-fired power station, and there is heavy hunting pressure during the open season.
References: Putney (1982); Portecop & Benito-Espinal (1984a).
Source: Edouard Benito-Espinal and Jacques Portecop.
Criteria for inclusion: 3a.

Moule Mangroves (7)

Location: 16°20'N, 61°20'W; east and west of Moule on the northeast coast of Grande-Terre, Guadeloupe.
Area: c.50 ha.
Altitude: 0m.
Province and type: 8.41.13; 02, 05 & 08.
Site description: Mangrove swamps in the Baie du Nord Ouest and the small estuary of the Riviere d'Audoin, and adjacent sandy beaches.
Principal vegetation: Mangrove swamps with *Laguncularia racemosa, Conocarpus erectus, Rhizophora mangle* and *Thespesia populnea*; littoral vegetation, dry woodland and cactus scrub in surrounding areas.
Land tenure: Public land (state owned).
Protection: None.
Land use: The town of Moule lies between the two swamps and there is cultivation inland.
Waterfowl: An important area for Ardeidae and migratory shorebirds.
Other fauna: There are coral reefs offshore.
Threats: Pollution from domestic waste, and heavy hunting pressure during the open season.
References: Putney (1982).
Source: Edouard Benito-Espinal and Jacques Portecop.
Criteria for inclusion: 0.

Pointe des Chateaux Lagoons (8)

Location: 16°15'N, 61°11'W; at the eastern tip of Grande-Terre, Guadeloupe.
Area: c.25 ha.
Altitude: Near sea level.

Province and type: 8.41.13; 05 & 07.
Site description: A group of shallow saline lagoons and adjacent sandy beaches on a peninsula at the extreme eastern tip of the island.
Principal vegetation: Littoral vegetation in surrounding areas.
Land tenure: Public land (state owned).
Protection: None.
Land use: Tourist recreation along the coast.
Waterfowl: An important area for migratory shorebirds, particularly during the autumn passage. Common species include *Tringa flavipes, T. solitaria, Catoptrophorus semipalmatus, Arenaria interpres, Actitis macularia, Calidris pusilla* and *C. melanotos.*
Other fauna: The sea turtle *Eretmochelys imbricata* nests on the beaches and there are coral reefs offshore.
Threats: Illegal sand mining.
Research and conservation: The entire peninsula has been proposed as a protected area.
References: Putney (1982).
Source: Edouard Benito-Espinal.
Criteria for inclusion: 3a.

Marais de Folle Anse (9)

Location: 15°56'N, 61°19'W; south of St-Louis, on the west coast of Marie-Galante Island.
Area: 400 ha.
Altitude: 0-1m.
Province and type: 8.41.13; 05, 07, 08, 10 & 18.
Site description: A complex of fresh to brackish marshes, mangrove swamps and *Pterocarpus* swamp forest behind a sea beach. The Riviere de St-Louis flows through the northern part of the marshes.
Principal vegetation: Mangrove swamps with *Laguncularia racemosa* and *Rhizophora mangle*, swamp forest with *Pterocarpus officinalis*, fresh to brackish marshes with *Cladium jamaicensis*, and littoral vegetation; extensive beds of sea-grasses offshore.
Land tenure: Public land (state owned).
Protection: None.
Land use: Hunting and sand mining; agriculture and grazing inland.
Waterfowl: An important area for a wide variety of waterfowl. *Ixobrychus exilis, Nyctanassa violacea, Butorides virescens, Gallinula chloropus* and *Porphyrula martinica* breed, and *Bubulcus ibis, Egretta thula* and *E. alba* are common feeding visitors. Regular passage migrants and winter visitors include *Ardea herodias, Dendrocygna bicolor, Anas discors, A. clypeata, Oxyura dominica, Porzana carolina* and fourteen species of Nearctic shorebirds.
Other fauna: Sea turtles nest on beaches in the south.
Threats: The principal threats are the extraction of sand from the beach between the marshes and the sea, and domestic pollution from the town of St-Louis to the north. There is heavy hunting pressure during the open season.
Research and conservation: The wetland was identified by Putney as an area with multiple resource values, and has been included in a proposed protected area.
References: Putney (1982).
Source: Edouard Benito-Espinal and Jacques Portecop.
Criteria for inclusion: 3a.

Grand Etang de Simsonbaai (10)

Location: 18°04'N, 63°07'W; near the west end of Saint Martin / Sint Maarten Island.
Area: 1,250 ha; about 630 ha in French territory.
Altitude: 0m.
Province and type: 8.41.13; 07 & 08.

Site description: A large permanent saline lagoon, up to 6m deep, with a salinity of 33 p.p.t., and with some fringing mangroves; there is a narrow channel connecting the lagoon with Baie Nettle to the north. About 50% of the lagoon lies in the Dutch part of the island (see Netherlands Antilles site 11).
Principal vegetation: Patches of mangroves with *Avicennia germinans, Laguncularia racemosa, Conocarpus erectus* and *Rhizophora mangle.*
Land tenure: A mixture of public and private ownership.
Protection: None. (The Dutch portion of the lagoon has been designated a protected area.)
Land use: Tourist development around much of the lagoon and grazing of domestic livestock in the east.
Waterfowl: An important feeding area for a variety of Ardeidae, migratory shorebirds and Laridae.
Other fauna: There is an important lobster and conch fishery in the lagoon.
Threats: The lagoon is under serious threat from the development of marinas, tourist hotels and other facilities along much of the shoreline, and domestic pollution from the town of Marigot in the northeast.
Research and conservation: The largest natural saline lagoon in the Lesser Antilles, but now much degraded, particularly on the Dutch side of the border.
References: Putney (1982).
Source: Edouard Benito-Espinal and Jacques Portecop.
Criteria for inclusion: 3a.

Etangs de Grand Case (11)

Location: 18°06'N, 63°03'W; near Grand Case, on the north coast of Saint Martin.
Area: 70 ha.
Altitude: 0m.
Province and type: 8.41.13; 07 & 08.
Site description: Three shallow saline lagoons with muddy shorelines; there are small patches of mangroves at two of the lagoons.
Principal vegetation: Mangroves; dry woodland in surrounding areas.
Land tenure: Public land (state owned).
Protection: None.
Land use: Grazing of domestic livestock around the lagoons and urban development nearby.
Waterfowl: An important feeding area for waterfowl, particularly Ardeidae and migratory shorebirds. Late autumn counts in 1983 and 1984 included up to *15 Pelecanus occidentalis, 77 Egretta thula, 10 Gallinula chloropus, 106 Tringa flavipes, 20 Actitis macularia* and 40 *Himantopus himantopus.*
Other fauna: No information.
Threats: Domestic pollution from the town of Grand Case.
References: Putney (1982).
Source: Edouard Benito-Espinal.
Criteria for inclusion: 3a.

Etang Chevrise and Cul-de-Sac (12)

Location: 18°06'N, 63°02'W; on the northeast coast of Saint Martin.
Area: c.30 ha.
Altitude: 0m.
Province and type: 8.41.13; 07 & 08.
Site description: A saline lagoon (Etang Chevrise) with muddy shoreline, and an area of mangrove swamps around a small sea bay (Cul-de-Sac).
Principal vegetation: Mangroves; extensive sea-grass beds offshore and dry woodland inland.
Land tenure: Etang Chevrise is public land (state owned); the Cul-de-Sac area is privately owned.

Protection: None.
Land use: Grazing of domestic livestock and urban development around Cul-de-Sac.
Waterfowl: A feeding area for *Pelecanus occidentalis*, Ardeidae and migratory shorebirds. Late autumn counts in 1983 and 1984 included up to 105 *Egretta thula* and smaller numbers of five other species of Ardeidae and nine species of shorebirds.
Other fauna: No information.
Threats: Seaborne pollution in Cul-de-Sac bay.
References: Putney (1982).
Source: Edouard Benito-Espinal.
Criteria for inclusion: 0.

Etang aux Poissons (13)

Location: 18°04'N, 63°02'W; on the east coast of Saint Martin.
Area: 140 ha.
Altitude: 0m.
Province and type: 8.41.13; 07 & 08.
Site description: A shallow saline lagoon with mangrove swamps.
Principal vegetation: Mangroves; littoral vegetation on the adjacent coast and dry woodland inland.
Land tenure: Public land (state owned).
Protection: None.
Land use: Tourism along the coast.
Waterfowl: A feeding area for Ardeidae and migratory shorebirds.
Other fauna: No information.
Threats: No information.
Research and conservation: Identified by Putney as one of the largest remaining relatively unaltered saline lagoons in the Lesser Antilles.
References: Putney (1982).
Source: Edouard Benito-Espinal.
Criteria for inclusion: 3a.

Wetlands on Saint-Barthelemy (14)

Location: 17°54'N, 62°50'W; east and central Saint-Barthelemy.
Area: c.45 ha.
Altitude: Near sea level.
Province and type: 8.41.13; 01, 05, 07 & 08.
Site description: Six saline lagoons: Grande Saline (16 ha) in the interior of the island, Etang du Grand Cul-de-Sac (7 ha), Etang du Petit Cul-de-Sac (3.5 ha) and Etang de Toiny (1.5 ha) near the east end of the island, and Etang de St. Jean (8 ha) and Etang de Public (3 ha) near Gustavia; and an area of mangroves and sandy beaches at Anse de Marigot on the northeast coast.
Principal vegetation: Mangrove swamps with *Avicennia germinans, Laguncularia racemosa* and *Conocarpus erectus* at Anse de Marigot; also some mangroves at Etang du Grand Cul-de-Sac, Etang du Petit Cul-de-Sac and Etang de St. Jean, and beds of *Ruppia maritima.* Cactus scrub and secondary vegetation in surrounding areas.
Land tenure: The saline lagoons are public land (state owned); other areas are privately owned.
Protection: None.
Land use: Grazing of domestic livestock; tourism along the coast, and urban development north of Etang de St. Jean.
Waterfowl: The lagoons provide a feeding area for a wide variety of passage and wintering waterfowl, particularly migratory shorebirds. Birds recorded during a survey of three ponds in December 1983 included *Nyctanassa violacea, Bubulcus ibis, Ardea herodias, Anas discors, Porzana carolina, Fulica americana, Himantopus himantopus* and over 170 Nearctic shorebirds of nine species.

Other fauna: No information.
Threats: Pollution from domestic waste at Grande Saline, and seaborne pollution at Anse de Marigot.
References: Putney (1982); Portecop & Benito-Espinal (1984a).
Source: Edouard Benito-Espinal.
Criteria for inclusion: 3a.

GRENADA

INTRODUCTION

No information was received on the current situation in Grenada and its dependencies in the Grenadines. The following account is based on Vincent (1981), IUCN (1982 & 1983) and Putney (1982).

Grenada and its dependencies in the southern Grenadines are the most southerly of the Windward Islands in the Lesser Antilles. Grenada is a mountainous volcanic island rising to a peak at 840m; it is 344 km^2 in extent and has a humid tropical climate supportingextensive rain and cloud forests in the interior. The Grenada Grenadines to the northeast of Grenada comprise some twenty low-lying limestone islands and rocks with cactus scrub and dry woodland. Only the three largest islands, Carriacou, Petit Martinique and Ronde, are inhabited. Grenada achieved full independence in 1974; the islands have a population of about 110,000 and an economy based on agriculture, particularly the cultivation of spices.

There are several small wetlands on the main island, including a crater lake, fresh and saline ponds in the lowlands, and mangroves along the south coast. The only wetlands in the Grenadines are some small patches of mangroves on Carriacou and a saline pond with mangroves on Saline Island, a tiny island off the south coast of Carriacou. There are many beaches with nesting sea turtles (*Chelonia mydas, Dermochelys coriacea* and *Eretmochelys imbricata*), offshore islets with sea-bird colonies and patches of coral reef throughout the islands, and extensive sea-grass beds off the east and south coasts of Grenada and off western Carriacou.

The government department responsible for conservation is the Forestry Division within the Ministry of Agriculture. The Grenada Historical Society, a non-governmental body created in 1976, is concerned not only with the preservation of historical sites but also with the protection of areas for conservation purposes, and has worked in close collaboration with the Government on a project for the establishment of a protected area around a small lake (Levera Pond). Relevant legislation includes the Ordinance for the Protection of Forests, Soil and Water Conservation (1949, 1954 and 1958), the Ordinance for the Protection of Birds and other Wildlife (1956, 1964 and 1966), and the Ordinance for the Protection of Territorial Waters against Oil Spills (1934 and 1958). By 1981, only two protected areas had been established; Grand Etang Forest Reserve (1,544 ha) established in 1910 in the interior highlands of Grenada, and a protected area incorporating an islet off northwestern Carriacou.

WETLANDS

No recent information is available on the wetlands of Grenada and the southern Grenadines. The following site descriptions are based on Lack & Lack (1973), Vincent (1981) and Putney (1982). (For map, see Dominica.)

Levera Pond (1)

Location: 12°13'N, 61°37'W; at the northeast tip of Grenada.
Area: c.30 ha.
Altitude: 0m.
Province and type: 8.41.13; 07, 08 & 16.
Site description: A brackish pond with an average depth of 3m, completely surrounded by mangrove swamps and seasonally flooded grassland. Flooding occurs during the wet season, from June to December; at high levels the pond breaks through to the sea, and during periods of high tides and storms there is an inflow of sea water.
Principal vegetation: Mangrove swamps dominated by *Rhizophora mangle* with *Laguncularia racemosa* and a few stands of *Avicennia germinans*, some submergent vegetation, and fresh to brackish marshes; cactus scrub in surrounding areas.
Land tenure: A mixture of public and private ownership.
Protection: None.
Land use: Some harvesting of crabs.
Waterfowl: A breeding area for Ardeidae (*Bubulcus ibis* and *Egretta caerulea*), and a feeding and roosting area for a wide variety of migratory waterfowl from both North and South America. Species recorded include *Podilymbus podiceps, Pelecanus occidentalis, Anhinga anhinga, Nycticorax nycticorax, Nyctanassa violacea, Butorides virescens, Ardea herodias, Eudocimus ruber, Dendrocygna arborea, Oxyura jamaicensis, Gallinula chloropus, Fulica caribaea*, seventeen species of Nearctic shorebirds and *Larus atricilla*.
Other fauna: Over 80 species of birds have been recorded in the Levera area, including most of Grenada's resident birds, and migrant *Pandion haliaetus, Falco columbarius* and *Seiurus noveboracensis*. *Iguana iguana* forages in the swamp; a variety of fish species including the introduced *Tilapia mossambica* are common; and crabs, mainly land crabs *Geocarcinus* sp, are abundant.
Threats: Some of the mangroves have been destroyed, and large quantities of mud and silt are being deposited in the pond because of erosion in the watershed.
Research and conservation: Identified by Putney as an area with multiple resource values. Levera Pond and the nearby Sugar Loaf, Green Island and Sandy Island have been incorporated in a proposed protected area.
References: Vincent (1981); Putney (1982).
Source: See references.
Criteria for inclusion: 3a.

Lake St. Antoine (2)

Location: 12°11'N, 61°37'W; 2 km northeast of Tivoli, in the northeast lowlands of Grenada.
Area: c.25 ha.
Altitude: Near sea level.
Province and type: 8.41.13; 12.
Site description: A small freshwater lake and marshes.
Principal vegetation: Freshwater marshes; dry woodland in surrounding areas.
Land tenure: Privately owned.
Protection: None.
Land use: Some tree crops and grazing in the area.
Waterfowl: A breeding area for *Podilymbus podiceps, Oxyura jamaicensis and Fulica caribaea* and Ardeidae (30 observed in 1971).
Other fauna: No information.

Threats: No information.
References: Lack & Lack (1973); Putney (1982).
Source: See references.
Criteria for inclusion: 3a.

Grand Etang (3)

Location: 12°05'N, 61°42'W; in the southern highlands of Grenada, 7 km northeast of St. George's.
Area: 15 ha.
Altitude: c.500m.
Province and type: 8.41.13; 12.
Site description: An old freshwater crater lake with some fringing marshes.
Principal vegetation: Freshwater marshes; tropical rain forest in surrounding areas.
Land tenure: Public land (state owned).
Protection: Within the Grand Etang Forest Reserve (1,544 ha) established in 1910.
Land use: Multiple use forestry in the reserve.
Waterfowl: *Butorides virescens* occurs in the marshes.
Other fauna: The introduced monkey *Ceropithecus mona* occurs in the reserve.
Threats: No information.
References: Lack & Lack (1973); IUCN (1982); Putney (1982).
Source: See references.
Criteria for inclusion: 3a.

Calivigny Mangrove Swamps (4)

Location: 12°00'N, 61°44'W; along the south coast of Grenada between Prickly Bay and St. David's Point.
Area: Several hundred ha.
Altitude: 0m.
Province and type: 8.41.13; 01, 05, 07 & 08.
Site description: Mangrove swamps, associated brackish to saline marshes and sandy beaches in Prickly Bay, Woburn Bay and Westerhall Bay; the largest mangrove system in the southern Windward Islands.
Principal vegetation: Mangroves; cultivated land and cactus scrub inland, and sea-grass beds offshore.
Land tenure: Privately owned.
Protection: None.
Land use: Sand mining in Prickly Bay, solid waste disposal in Woburn Bay, and tourism in Westerhall Bay; cultivation inland.
Waterfowl: No information.
Other fauna: There is a sea-bird colony on Hog Island in Woburn Bay; the sea turtles *Dermochelys coriacea* and *Eretmochelys imbricata* nest on the beaches; and there are very rich marine resources offshore.
Threats: There is some seaborne pollution in the area.
References: Putney (1982).
Source: See references.
Criteria for inclusion: 3a.

Point Salines Ponds (5)

Location: 12°00'N, 61°47'W; at the southwest tip of Grenada.
Area: A few ha.
Altitude: Near sea level.

Province and type: 8.41.13; 05 & 07.
Site description: Two small saline lagoons with fringing mudflats and adjacent sandy beaches.
Principal vegetation: Cultivation and cactus scrub in surrounding areas.
Land tenure: Privately owned.
Protection: None.
Land use: None.
Waterfowl: An important area for migratory shorebirds. Lack & Lack recorded thirteen species of shorebirds including large numbers of *Tringa flavipes*, *Calidris pusilla*, *C. minutilla* and *Micropalama himantopus*. *Eudocimus ruber* has been recorded.
Other fauna: The sea turtle *Dermochelys coriacea* nests on the beaches.
Threats: No information.
References: Lack & Lack (1973); Putney (1982).
Source: See references.
Criteria for inclusion: 0.

Carriacou Mangroves (6)

Location: 12°28'N, 61°29'W; at the west end of Carriacou Island, Grenadines.
Area: c.100 ha.
Altitude: 0m.
Province and type: 8.41.13; 01, 05 & 08.
Site description: Coastal mangrove swamps and adjacent sandy beaches in three small bays.
Principal vegetation: Mangroves and littoral vegetation; dry woodland inland, and some sea-grass beds offshore.
Land tenure: Public land (state owned).
Protection: None.
Land use: Grazing by domestic livestock on adjacent land.
Waterfowl: No information.
Other fauna: Sea turtles nest on the beaches, and there are commercially important beds of the tree-oyster *Isognomon alatus*.
Threats: There is some seaborne pollution.
References: Putney (1982).
Source: See references.
Criteria for inclusion: 0.

Saline Island Pond (7)

Location: 12°26'N, 61°28'W; on Saline Island, to the south of Carriacou in the Grenadines.
Area: A few ha.
Altitude: Near sea level.
Province and type: 8.41.13; 05, 07 & 08.
Site description: A small saline lagoon with fringing mangrove swamps and nearby sandy beaches.
Principal vegetation: Mangroves.
Land tenure: Privately owned.
Protection: None.
Land use: None; the island is uninhabited.
Waterfowl: No information.
Other fauna: The sea turtle *Eretmochelys imbricata* nests on the beaches, and there are coral reefs offshore.
Threats: There is some seaborne pollution around the island.
References: Putney (1982).
Source: See references.
Criteria for inclusion: 0.

HAITI

INTRODUCTION

based on information provided by Joseph Felix, Rony Kavanaght, James O. Keith, Paul Paryski, James J. Talbot and Charles A. Woods

The Republic of Haiti occupies the western third of the island of Hispaniola and has a population of over 5.5 million. With an area of 27,750 sq. km and coastline of 1,500 km, it is the third largest state in the Caribbean after Cuba and the Dominican Republic. The land area includes several large islands, La Gonave (680 sq. km), La Tortue (180 sq. km), Ile-a-Vache (52 sq. km) and the Cayemites (45 sq. km), as well as a number of smaller islands and cays. The topography is extremely rugged, with three mountain ranges extending from east to west across the country and rising to peaks of up to 2,674m. The climate is tropical, tempered by sea breezes; temperatures in coastal regions range from 20°C to 35°C, and the main rainfall occurs during the summer months. Due to the mountainous topography, the annual rainfall shows great regional variations, from less than 300 mm in the northwest to over 4,000 mm in the mountains of the southwest. The economy is based to a large extent on agriculture, with coffee, sugar and sizal as the main export crops.

The dense human population, intensive agriculture and heavy reliance on charcoal for fuel have resulted in extreme degradation of terrestrial environments, and very little natural vegetation now remains intact except in some of the remotest mountain regions. The aquatic ecosystems have, however, fared rather better. Extensive tracts of freshwater marsh, particularly on the floodplain of the Artibonite River and in the Forte Liberte area, have been converted into rice paddies, but the country's largest inland lake, Etang Saumatre, and most of the 22,000 ha of coastal mangrove swamps have remained almost undisturbed. The fishing industry is poorly developed and remains predominantly artisanal, but there are many aquaculture projects involving tilapia and carp, and some mariculture projects have recently been proposed.

Institutional Base for Wetland Conservation and Research

The main governmental agencies concerned with environmental conservation are as follows:

Ministere de l'Agriculture, des Ressources Naturelles et du Developpement Rural (MARNDR); the ministry concerned with agriculture, fisheries, forestry, soil conservation, wildlife protection and rural development. Within this ministry, the Service des Ressources en Peches is concerned with marine and freshwater fisheries and aquaculture, the Service des Ressources Forestieres et Protection de la Faune with forestry and wildlife protection (including the establishment of hunting regulations), and the newly created Service Protection Environment et Faune (Direction des Ressources Naturelles) with national parks and the preservation of the environment.

Institut de Sauvegarde du Patrimonie National (ISPAN). Founded in 1979 to protect Haiti's cultural and natural heritage, ISPAN was responsible for developing a national parks programme with the assistance of the U.S. Agency for International Development (US-AID). However, in 1983 it became a division of the newly created INAHCA, and its responsibilities were restricted to the administration of La Citadelle National Park, a tiny national park in the north of the country.

Institut National Haitien de la Culture et des Arts (INAHCA). This new institute, created in 1983 under the patronage of President Duvalier's wife, has taken over the National Parks Programme from ISPAN, and is responsible for the conservation of Haiti's natural heritage. It is currently setting up a new Museum of Natural Sciences in Port-au-Prince.

There are no non-governmental bodies directly concerned with conservation in Haiti, and indeed there is little concern or support for conservation amongst the general public. There is, however, a local Natural History Society and an Audubon Bird Club in Port-au-Prince with some support from well educated Haitians.

Progress in Wetland Conservation and Research

Haiti has a considerable amount of environmental legislation dating back to the Rural Code of 1826, which prohibited unauthorized cutting of trees. The Convention on the Protection of the Flora, Fauna and National Sceneries of the American Continent was approved in 1941, and the Decree of March 1963 on National Parks and Natural Areas provided the legal basis for the establishment of protected areas. Other relevant legislation includes a decree of 1978 and law of 1979 concerning fisheries and marine resources, which prohibit the cutting of mangroves.

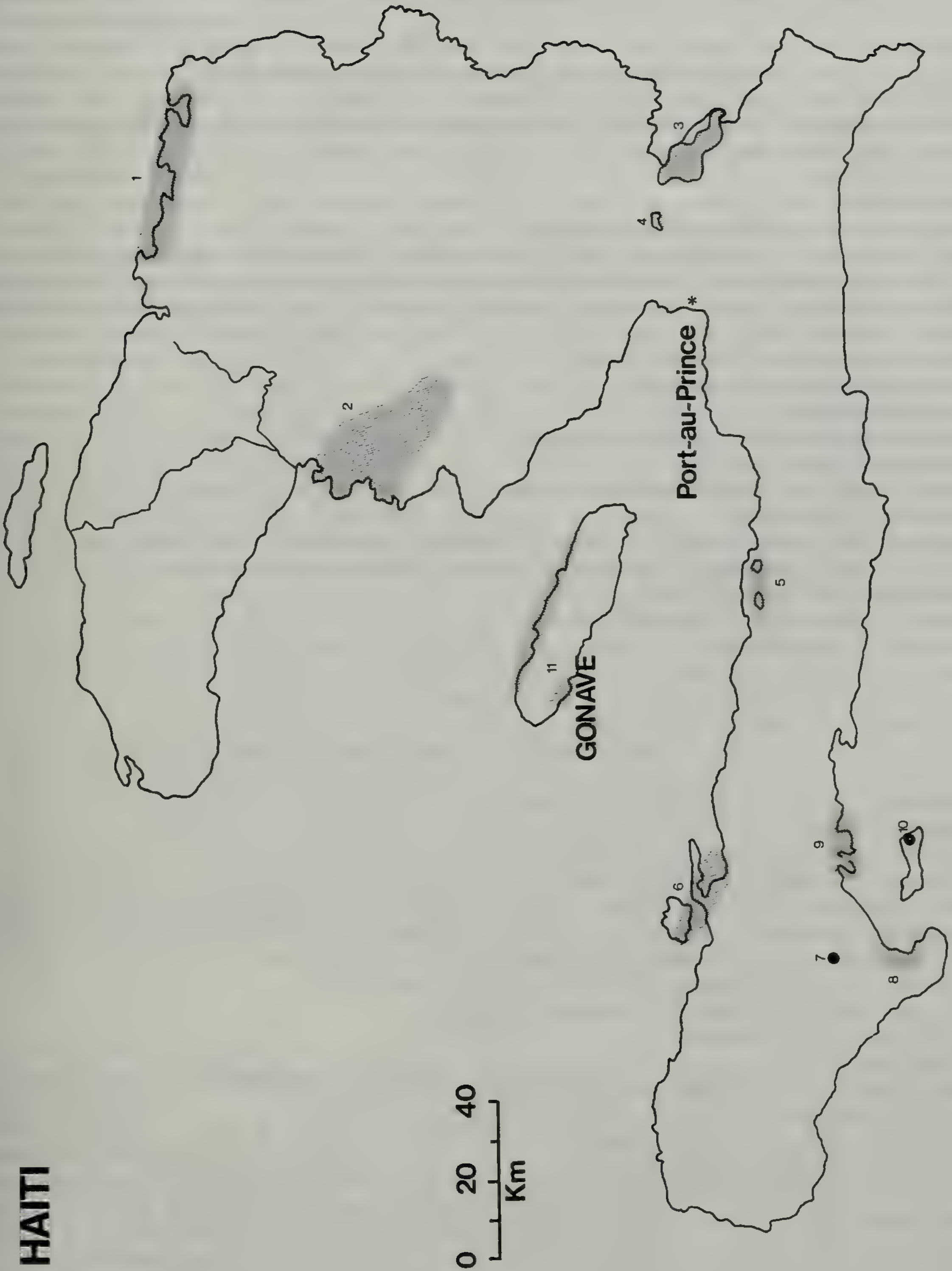
No wetlands are under protection. However, there are several small National Parks, including La Citadelle Henri Christophe (La Citadelle La Ferriere), and in 1983 two new National Parks, both of 2,000 ha, were created in the mountains of the southwest (Parc National La Visite and Parc National Macaya). The emphasis of these large National Parks is watershed conservation and the protection of endemic fauna and flora.

The Service Protection Environment et Faune has issued a list of protected animals and plants including forty-three species of birds. The hunting regulations issued by the Service des Ressources Forestieres et Protection de la Faune set open seasons and bag limits for Anatidae and some other waterfowl, but law enforcement is very poor and bags in excess of 100 ducks per day have been reported. However, there are only about one hundred licensed hunters in the country.

Very little research has been conducted on wetlands or wetland fauna. Rony Kavanaght at the Section d'Aquaculture et d'Hydrobiologie in the Service des Ressources en Peches, MARNDR, has conducted some studies on sea turtles and also a little work on inland wetland systems. Charles A. Woods and colleagues at the Florida State Museum with the support of US-AID have been conducting research on Haitian wildlife for over fifteen years and are currently initiating a major inventory of biological resources throughout Hispaniola. Although most of the research to date has focussed on the montane forest fauna, particularly the endemic mammals, the work has included a detailed study of the population of *Crocodylus acutus* at Etang Saumatre (by John Thorbjarnarson), and a survey of the status of the manatee *Trichechus manatus* in Haitian waters (by Galen B. Rathbun, Charles A. Woods and Jose A. Ottenwalder). The Country Environmental Profile carried out by US-AID in early 1985 stresses the importance of Haiti's coastal mangroves and marine resources, suggests several potential sites for marine reserves, and includes information collected by Mara A. McDonald and Tom Greathouse on the wetlands and their waterfowl.

Major Threats to Wetlands

The only serious threats to wetlands in Haiti at the present time are continued conversion of freshwater marshes to rice growing areas and drainage for other forms of cultivation. Some mangroves are cut for charcoal, and pollution from domestic sewage may be a problem locally, but pesticides are not widely used and there is relatively little disturbance from hunting and fishing activities.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WETLANDS

Site descriptions based on information provided by James O. Keith, Jose A. Ottenwalder, Paul Paryski, James J. Talbot, John Thorbjarnarson and Charles A. Woods.

The Caracol area and Baie de Forte Liberte (1)

Location: 19°45'N, 71°56'-72°12'W; east along the coast from Cap Haitien to the border with the Dominican Republic.
Area: 12,500 ha.
Altitude: 0m.
Province and type: 8.40.13; 01, 05, 07, 08 & 17.
Site description: A large sea bay east of Cap Haitien, with extensive mangrove swamps and offshore coral reefs; and an almost entirely enclosed sea bay (Baie de Forte Liberte) with mangrove swamps and adjacent sandy beaches to the east. There is extensive rice cultivation inland.
Principal vegetation: Mangrove swamps; rice fields.
Land tenure: No information.
Protection: None.
Land use: An important rice growing area.
Waterfowl: No information.
Other fauna: The manatee *Trichechus manatus* occurs in the area.
Threats: No information.
Research and conservation: The US-AID Country Environmental Profile identifies Baie de Forte Liberte (Labadie and Cadrasse) as a potential site for a marine reserve.
References: Rathbun *et al* (1982).
Source: James O. Keith and James J. Talbot.
Criteria for inclusion: 3a.

The floodplain and delta of the Artibonite River (2)

Location: 19°15'N, 72°40'W; south of Gonaives, 90 km NNW of Port-au-Prince.
Area: 47,500 ha.
Altitude: 0-5m.
Province and type: 8.40.13; 02, 07, 08, 09 & 17.
Site description: The lower Riviere de l'Artibonite, with extensive brackish coastal lagoons, mangrove swamps and saline flats in the delta, and large areas of rice cultivation inland. Most of the marshes of the floodplain have been converted to rice paddies. The bays and reefs along the coast of the delta have an abundance of marine vegetation.
Principal vegetation: Mangrove swamps; rice fields.
Land tenure: No information.
Protection: None.
Land use: There is an important fishery in the delta; the floodplain is an important rice growing area; and there is some cutting of mangroves for fuel.
Waterfowl: One of the most important wetlands for waterfowl in Haiti. Species recorded include *Podilymbus podiceps, Phalacrocorax auritus, Pelecanus occidentalis, Nycticorax nycticorax, Nyctanassa violacea, Egretta rufescens* (rare), *Plegadis falcinellus* (common), *Anas bahamensis, A. discors, Oxyura jamaicensis, Rallus longirostris, Fulica caribaea, Jacana spinosa, Charadrius wilsonius, Larus atricilla* and *Gelochelidon nilotica.* 600-700 *Phoenicopterus ruber* were present in May 1982, and 150-200 in May 1983.
Other fauna: There is a small population of the manatee *Trichechus manatus* in the delta.
Threats: The wetlands of the floodplain continue to be converted into rice paddies.
References: Rathbun *et al* (1982).
Source: James O. Keith, Jose A. Ottenwalder, Paul Paryski and James J. Talbot.
Criteria for inclusion: 2a & 3a.

Etang Saumatre (3)

Location: 18°35'N, 72°00'W; 35 km east of Port-au-Prince.
Area: 11,300 ha.
Altitude: 15m.
Province and type: 8.40.13; 13 & 14.
Site description: A large permanent brackish lake, up to 30m deep, with sparse aquatic vegetation; much of the shoreline is narrow and sandy, but there are extensive areas of shallow lagoons and mudflats along the eastern and western shores, and some freshwater springs with small marshes. The salinity of the lagoon is about 10 p.p.t. The water level fluctuates annually by about 50 cm, but there are longer term fluctuations of at least 2m with periods of drought and increased rainfall.
Principal vegetation: Only several species of algae in the lagoon itself; some fringing *Conocarpus erectus* thickets, and fresh to brackish marshes with *Typha domingensis*. In a region of dry subtropical forest.
Land tenure: The eastern shore is state owned; most of the western shore is privately owned.
Protection: None.
Land use: Fishing on a small scale, some duck hunting in winter and, locally, intensive cutting of *Conocarpus erectus* for charcoal.
Waterfowl: A very important breeding, passage and wintering area for a wide variety of waterfowl. There is a breeding colony of 300-400 pairs of Ciconiiformes at the east end of the lagoon, with *Nycticorax nycticorax, Nyctanassa violacea, Bubulcus ibis, Egretta caerulea, E. tricolor, E. thula, E. alba, Eudocimus albus* and *Plegadis falcinellus*. Other breeding species include *Podilymbus podiceps, Ixobrychus exilis, Butorides virescens, Gallinula chloropus, Jacana spinosa, Charadrius vociferus, Himantopus himantopus* and probably *Sterna albifrons*. Up to 300 *Phoenicopterus ruber* have been recorded as non-breeding visitors, and *Dendrocygna arborea* and *Fulica caribaea* occur regularly. Large numbers of Anatidae and shorebirds occur in winter, mainly *Anas americana, A. discors* (abundant), *Pluvialis squatarola, Charadrius wilsonius, Tringa melanoleuca, T. flavipes* and *Actitis macularia*. Other common migrants include *Larus atricilla, Hydroprogne caspia, Sterna maxima* and *S. hirundo*.
Other fauna: *Pandion haliaetus* is present year round, *Falco peregrinus* occurs on passage, and *Ceryle alcyon* is a common winter visitor. There is a large viable population of the American Crocodile *Crocodylus acutus*, and the freshwater turtle *Chrysemys decorata* and iguana *Cyclura cornuta* are common.
Threats: The *Conocarpus* thickets are being cut down for charcoal, and there is some hunting of flamingos and Anatidae.
Research and conservation: Basic faunal and floral inventories have been carried out, and Thorbjarnarson has conducted a detailed study of the *Crocodylus acutus* population.
References: Wiley & Wiley (1979); Thorbjarnarson (in prep).
Source: John Thorbjarnarson and Jose A. Ottenwalder.
Criteria for inclusion: 123.

Lac Caiman (4)

Location: 18°38'N, 72°08'W; 20 km NNE of Port-au-Prince.
Area: 2,500 ha.
Altitude: 12m.
Province and type: 8.40.13; 07 & 12.
Site description: A permanent, shallow, slightly brackish lake of 750 ha with extensive fresh to brackish marshes to the east, and some marshes and muddy areas at the west end.
Principal vegetation: Extensive marshes with *Typha domingensis*.
Land tenure: No information.
Protection: None.
Land use: Fishing on a small scale; agriculture and livestock grazing in surrounding areas.
Waterfowl: An important area for waterfowl, particularly in winter. Breeding birds include *Podilymbus podiceps, Gallinula chloropus* and a large population of *Fulica caribaea*. A variety of Ardeidae, *Plegadis falcinellus* and *Phoenicopterus ruber* are regular non-breeding visitors; 50 *P. ruber* and 150 *P. falcinellus* were present in March 1984. Wintering species

include a variety of Anatidae, notably *Anas americana* and *A. discors*, many shorbirds, *Larus atricilla, Gelochelidon nilotica* and *Hydroprogne caspia.*
Other fauna: No information.
Threats: No information.
Source: James O. Keith and Derek A. Scott.
Criteria for inclusion: 2b & 3a.

Miragoane Lakes (5)

Location: 18°24'N, 73°03'W; between Miragoane and Petit Goave, 75 km west of Port-au-Prince.
Area: 4,500 ha.
Altitude: 10m.
Province and type: 8.40.13; 12.
Site description: Two small freshwater lakes with extensive surrounding marshes, near the south shore of the Canal du Sud. The larger lake, Etang Miragoane, is very deep.
Principal vegetation: Marshes with *Typha* sp; in the subtropical moist forest life zone.
Land tenure: No information.
Protection: None.
Land use: No information.
Waterfowl: No information.
Other fauna: No information.
Threats: No information.
Source: Paul Paryski and James J. Talbot.
Criteria for inclusion: 0.

Cayemite Islands and Baie des Bararderes (6)

Location: 18°32'N, 73°40'W; 140 km west of Port-au-Prince.
Area: 11,000 ha.
Altitude: 0m.
Province and type: 8.40.13; 01 & 08.
Site description: Extensive mangrove swamps along the south side of the Cayemite Islands and in the Baie des Bararderes. There are shallow reefs offshore.
Principal vegetation: Mangrove swamps; abundant marine vegetation offshore.
Land tenure: No information.
Protection: None.
Land use: No information.
Waterfowl: No information.
Other fauna: The manatee *Trichechus manatus* may occur in the area.
Threats: No information.
Research and conservation: The US-AID Country Environmental Profile identifies the Cayemite Islands as a potential site for a marine reserve.
References: Rathbun *et al* (1982).
Source: Paul Paryski and James J. Talbot.
Criteria for inclusion: 0.

Lakes above Les Cayes (7)

Location: 18°19'N, 73°50'W; in the hills 19 km northwest of Les Cayes.
Area: c.300 ha.
Altitude: c.180m.
Province and type: 8.40.13; 12.

Site description: A group of three small freshwater lakes with fringing marshes in the foothills of the eastern slopes of the Massif du Sud. The only significant mountain lakes in Haiti.
Principal vegetation: No information.
Land tenure: No information.
Protection: None.
Land use: No information.
Waterfowl: No information.
Other fauna: No information.
Threats: No information.
Source: Paul Paryski.
Criteria for inclusion: 0.

Les Cayes Marshes (8)

Location: 18°11'N, 73°49'W; west of the town of Les Cayes.
Area: 7,000 ha.
Altitude: 0-5m.
Province and type: 8.40.13; 01, 05, 13 & 17.
Site description: A complex of small pools, marshes and wet arable land with numerous canals, adjacent to a shallow sea bay with sandy beaches (Baie des Cayes).
Principal vegetation: No information.
Land tenure: No information.
Protection: None.
Land use: No information.
Waterfowl: The marshes are known to be very important for waterfowl, but no census data are available. Species recorded include *Pelecanus occidentalis, Bubulcus ibis, Butorides virescens, Egretta caerulea, E. tricolor, E. thula, E. alba, Ardea herodias, Eudocimus albus, Pluvialis squatarola, Charadrius wilsonius, C. vociferus, Tringa solitaria, Actitis macularia, Arenaria interpres, Calidris alba* and *Gelochelidon nilotica.*
Other fauna: The manatee *Trichechus manatus* may occur in the bay.
Threats: No information.
References: Rathbun *et al* (1982).
Source: James O. Keith, Paul Paryski and James J. Talbot.
Criteria for inclusion: 0.

Baie d'Aquin (9)

Location: 18°14'N, 73°23'W; 35 km east of Les Cayes.
Area: 9,600 ha.
Altitude: 0m.
Province and type: 8.40.13; 01, 03, 04, 07 & 08.
Site description: A brackish lagoon with extensive mangrove swamps to the west; and a large sea bay with small offshore islands, mangrove swamps and rocky sea shores.
Principal vegetation: Mangrove swamps.
Land tenure: No information.
Protection: None.
Land use: No information.
Waterfowl: A variety of Ardeidae were observed during an aerial survey in May 1983.
Other fauna: The manatee *Trichechus manatus* may occur in the bay.
Threats: No information.
References: Rathbun *et al* (1982).
Source: Paul Paryski and Jose A. Ottenwalder.
Criteria for inclusion: 0.

Eastern Ile-a-Vache (10)

Location: 18°04'N, 73°35'W; 20 km southeast of Les Cayes.
Area: 1,700 ha.
Altitude: 0m.
Province and type: 8.40.13; 01 & 08.
Site description: Extensive mangrove swamps at the eastern end of Ile-a-Vache, with coral reefs offshore in the Canal de l'Est.
Principal vegetation: Mangrove swamps.
Land tenure: No information.
Protection: None.
Land use: No information.
Waterfowl: No information.
Other fauna: The manatee *Trichechus manatus* may occur in the area.
Threats: No information.
Research and conservation: The US-AID Country Environmental Profile identifies the area as a potential site for a marine reserve.
References: Rathbun *et al* (1982).
Source: Paul Paryski and James J. Talbot.
Criteria for inclusion: 0.

Wetlands of Ile de La Gonave (11)

Location: 18°55'N, 73°00'W; on the north and southwest coasts of Ile de La Gonave.
Area: At least 5,000 ha.
Altitude: 0m.
Province and type: 8.40.13; 07 & 08.
Site description: A chain of coastal lagoons, mangrove swamps and brackish marshes stretching along the north coast of the island, and one large lagoon and marsh on the southwest coast.
Principal vegetation: Mangrove swamps and brackish marshes.
Land tenure: No information.
Protection: None.
Land use: No information.
Waterfowl: Known to be an important area for waterfowl, but few data are available. Small breeding colonies of Ardeidae (*Bubulcus ibis, Egretta caerulea, E. thula* and *E. alba*) were located at La Cayenne and Gros Mangle during an aerial survey in May 1982, and small flocks of *Phoenicopterus ruber* have been observed (37 birds in May 1982, and 50-60 in May 1983).
Other fauna: *Columba leucocephala* occurs in the mangroves.
Threats: No information.
Source: Jose A. Ottenwalder and Charles A. Woods.
Criteria for inclusion: 0.

JAMAICA

INTRODUCTION

by **Patrick W. Fairbairn and Ann Haynes**

Jamaica, with an area of 10,962 km^2, is the third largest island in the Caribbean. It lies 140 km south of Cuba and 730 km west of Haiti, and has a population of about 2.1 million (1977). The island is crossed by a range of mountains reaching 2,256m in the east and descending gradually towards the west, with a series of spurs and forested valleys running north and south. The climate is tropical, with a fairly high humidity; temperatures on the coast average 27°C and there is a rainy season during the summer months (May to September). Much of the native vegetation, particularly in the lowlands, has been cleared for agriculture, mainly sugar, tobacco, bananas, coffee and palm products. Most of Jamaica's wetlands are coastal, and these include shallow sea bays, tidal creeks and brackish to saline lagoons with mangrove swamps. There are large freshwater swamps and peat marsh systems along the Black River and at Negril, but otherwise there are few freshwater wetlands of any significance.

Institutional Base for Wetland Conservation and Research

Governmental

The Natural Resource Conservation Department (NRCD) is the only agency with an explicit concern for the management of wetland areas. Its present activities are scientific, legal (through the Wild Life Protection Act), advisory (through the development control process of the Town and Country Planning Department), and coordinative, with the ultimate prospect of managing selected wetlands as National Parks or wildlife reserves.

The Petroleum Corporation of Jamaica (PCJ), a quasi-governmental body devoted to development of indigenous energy resources, has a current interest in mining peat from the island's two largest wetlands. It also plans to manage a smaller coastal wetland area as a crocodile sanctuary and semi-private beach resort. So far its activities have concentrated on scientific research.

The Fisheries Division has the legal power, through the Fishing Industry Act, to designate Fish Sanctuaries which may include mangrove swamps and other coastal wetlands. One such area is currently protected in this way.

Non-governmental

The University of the West Indies (Mona Campus) periodically conducts research on specific wetlands and wetland problems. The other non-governmental organizations with a record of concern for wetland conservation are all small groups each with fewer than one hundred active members. These are: The Natural History Society of Jamaica, Gosse Bird Club, and the Jamaican Society of Scientists and Technologists. Activities include excursions, lectures, seminars and public education through the mass media.

Progress in Wetland Conservation and Research

In the first National Physical Plan in 1971, the island's major wetlands were delineated as areas for special attention and care. However, conservation of wetlands as wetlands is still not a concept widely accepted by Government itself, and various wetland drainage or reclamation schemes in progress in 1971 have continued to the present day,

Legal protection for wetlands and their wildlife in Jamaica has its basis in several laws. Under the Town and Country Planning Act, Development Orders have been promulgated for each of the thirteen parishes. In each Development Order, there is a map delineating among other things areas of special conservation value, a definition which includes all wetlands regardless of size. However, the degree of real protection afforded by this designation is highly problematic, since to date no major development has been successfully challenged under the provisions of this Act. An inherent weakness in the Act is the fact that the definition of development is so worded as to exclude agriculture from the development control process.

Under the Wild Life Protection Act, wetland animals may be protected by the listing of individual species and the designation of sanctuaries. Thus the American Crocodile *Crocodylus acutus* and the West Indian Manatee *Trichechus manatus* are totally protected in law as Protected Animals, as are almost all birds except some pests and certain game species for which an open season may be declared. Although extensive upland areas have been designated as sanctuaries under this Act, no wetlands have as yet been accorded such status except in those few cases where they lie within the bounds of Crown Lands, which are by definition closed to hunting. Administration and enforcement of the Wild Life Protection Act are inadequate despite the efforts of the Natural Resource Conservation Department to educate the general public and promote observance by means of four full-time Conservation Wardens appointed primarily for this purpose.

Coastal habitats including wetlands may be protected under the Fishing Industry Act as Fish Sanctuaries. One small example of this is a mangrove lagoon in the vicinity of Montego Bay; a much larger mangrove ecosystem at Portland Bight is awaiting enactment.

Much of the wetland research conducted in Jamaica to date has focussed on the Negril and Black River Lower Morasses, mainly because of the great size of these wetlands and their potential for multiple use. During the late 1970s, both were studied by the NRCD as part of a training programme sponsored by the Canadian International Development Agency (CIDA). Particular attention was given to the potential of Negril Morass as a National Park, and a proposal was made for the captive rearing and release of several duck species in artificially reflooded areas.

The NRCD also strongly favoured the establishment of a National Park at the Black River Lower Morass, but this concept was put in abeyance in 1979 by the onset of research on the mining of peat for fuel. Studies conducted by both the NRCD and the Petroleum Corporation of Jamaica predict that peat mining would result in the destruction of about 50% of the Jamaican habitat of several species of Rallidae and the shallow-water environments preferred by juvenile *Crocodylus acutus* and many other wetland animals. The open water pools created by the mining activities would, however, undoubtedly favour some species of waterfowl, notably Podicipedidae and wintering Anatidae.

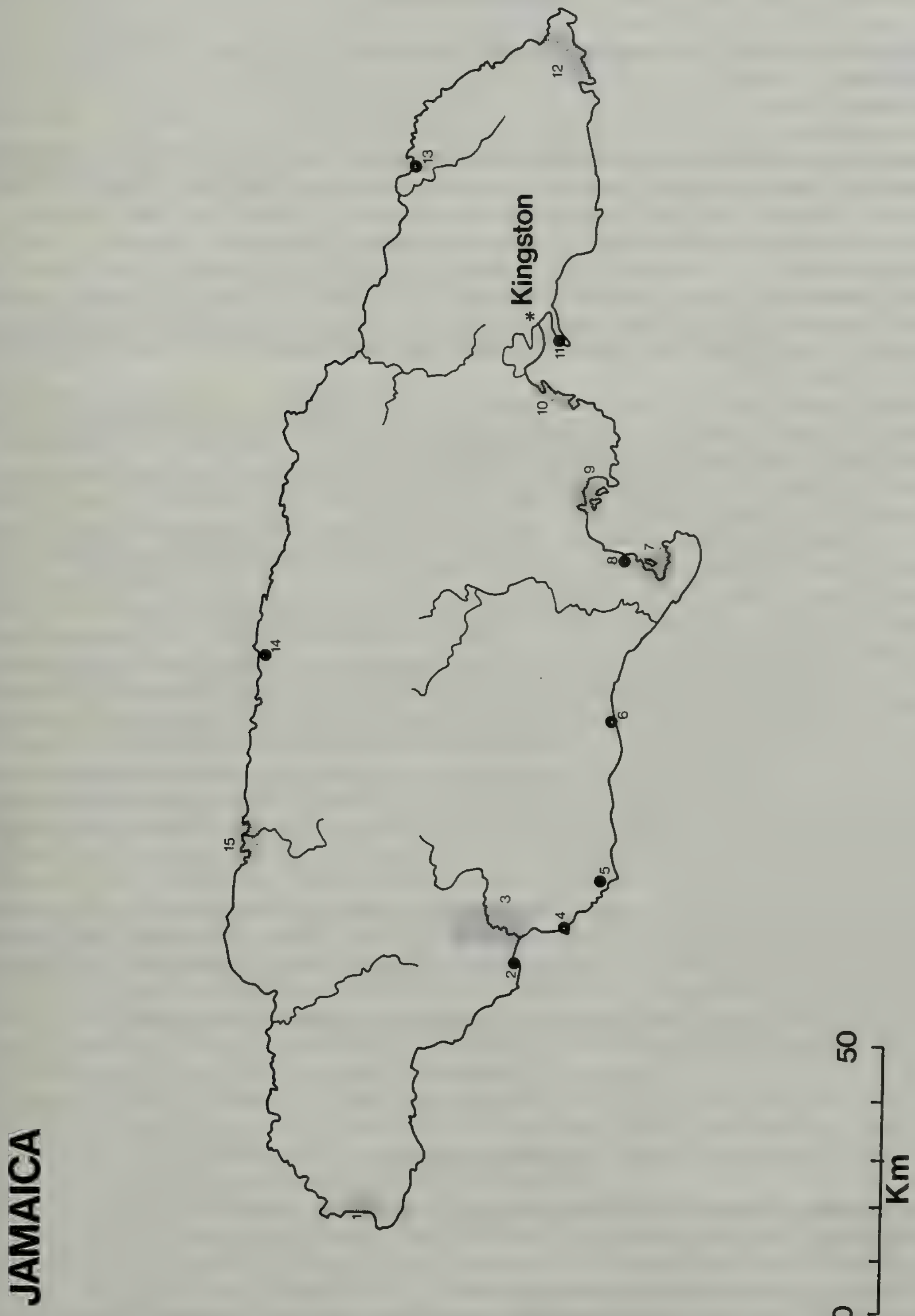
The Portland Bight coastal ecosystem is currently being studied by the NRCD to describe the area's major ecological components and functions. Results of the study are expected to make a useful contribution to the biophysical inventory of Portland Bight and its environs, which comprise a designated National Park area in the National Physical Plan.

Another designated National Park area, centred on the coast of the Manchester Parish, contains a wetland that serves as the focus of a manatee management project and concurrent interpretative programme, sponsored jointly by the NRCD and the Organization of American States with additional technical assistance from the Florida State Museum. A visitor centre is being constructed to house collections of biota from the area and other educational material for display. Submerged macrophytes are being monitored in the Alligator Hole River, the habitat of the manatees.

A major scientific study of the Hellshire coast southwest of Kingston is expected to start in 1985. Arising from the collaboration of the University of Dalhousie, Nova Scotia, and the Mona Campus of the University of the West Indies, and under the sponsorship of CIDA, this research will include investigations of a large mangrove and saline ecosystem that lies between low limestone hills and a shallow offshore shelf of patch reef and turtle grass *Thalassia* sp. This wetland study is of special urgency because of plans to build the so-called Hellshire New Town in the hills nearby, and to develop the recreational potential of the area's beaches.

Major Threats to Wetlands

Despite recognition in the National Physical Plan and Parish Development Orders as areas of special conservation value, Jamaica's wetlands remain under threat, particularly from drainage for agriculture and reclamation for housing and industrial development. The mangroves of Kingston Harbour continue to be destroyed for housing, and drainage for agriculture has now almost completely destroyed the once extensive marshes of the Black River Upper Morass. The mangrove swamp at the mouth of the Martha Brae River near Falmouth was unsuccessfully drained in the 1960s and 1970s for rice cultivation, and is being gradually removed by urban encroachment and recreational development, with the resultant degradation of a famous phosphorescent lagoon. The Cabarita Swamp in Westmoreland suffers from the continuing stress of canalization and pollution with waste products from a sugar factory and rum distillery. Elsewhere, other wetlands are at risk from smaller-scale developments with similar effects. A new possible source of disturbance that would drastically change wetland habitats in the Negril and Black River Lower Morasses is embodied in the current proposal to mine peat desposits for fuel. In the process, herbaceous swamps would be converted into deep open-water lakes.



WETLANDS

Site descriptions based on data sheets provided by the Aquatic Resources Division of the Natural Resource Conservation Department, and Robert L. Sutton.

Negril Morass (1)

Location: 18°19'N, 78°20'W; northeast of Negril, Westmoreland and Hanover Parishes.
Area: 2,300 ha.
Altitude: 0m.
Province and type: 8.40.13; 05, 07, 08, 13, 18 & 19.
Site description: A coastal fringe of mangrove swamps and tidal marshes behind a sand bar, and extensive fresh to brackish marshes with peat formations 5-6m deep inland. Salinities range from 1-20 p.p.t., and there are slight tidal fluctuations in water level near the coast. The marshes have been greatly modified by various attempts at drainage in the past. The water level was lowered in 1959, and this led to a spread of sawgrass and invasion by shrubs and trees.
Principal vegetation: Coastal mangrove swamps, principally *Rhizophora mangle*; extensive stands of sawgrass *Cladium jamaicensis*; swamp forest dominated by *Rystonea princeps*; and scattered shrubs and trees. The vegetation, which includes endemic species, has been described in detail by Bjork (1983).
Land tenure: Owned partly by the state and partly by the Petroleum Corporation of Jamaica.
Protection: No legal protection; a designated Conservation Area in Parish Development Orders, and proposed National Park in the National Physical Plan.
Land use: Fishing, crab hunting and illegal cultivation of marijuana; 200 ha of marsh have been drained for agriculture in the east.
Waterfowl: Resident species include *Podilymbus podiceps, Ixobrychus exilis, Butorides virescens, Egretta caerulea, E. alba, Rallus longirostris, Porzana flaviventer* and *Gallinula chloropus*; winter visitors include *Ardea herodias, Anas discors, Porzana carolina* and *Gallinago gallinago*. West Indian Tree Ducks *Dendrocygna arborea* occur regularly.
Other fauna: No information.
Threats: Sections of the wetland have already been drained for agriculture. A proposal by the Petroleum Corporation of Jamaica to mine the high quality peat desposits for fuel is likely to be given the go-ahead, and this will involve the physical removal of sections of the wetland and creation of deep-water lakes.
Research and conservation: A number of studies have been conducted on the feasibility of peat mining and its environmental impact, particularly by the Petroleum Corporation of Jamaica and University of Lund, Sweden. Several workers have concluded that the peat mining activities would in fact enhance the wildlife values of the area by "rejuvenating" the marsh and increasing habitat diversity.
References: Adelatec (1969); Natural Resource Conservation Department (1975); Natural Resource Conservation Department & Traverse Group, Inc. (1981); Bjork (1982, 1983 & 1984); Coke *et al* (1982); Handy (1982); Cronberg (1983); Fritzon (1983); Svensson (1983); Digerfeldt & Enell (1984); Enell (1984).
Source: Aquatic Resources Division, Natural Resource Conservation Department.
Criteria for inclusion: 2b & 3a.

Luana Swamp (2)

Location: 18°07'N, 77°59'W; west of Black River, St. Elizabeth Parish.
Area: Unknown.
Altitude: 0m.
Province and type: 8.40.13; 05, 06, 07 & 08.
Site description: An area of tidal mudflats, mangrove swamps and brackish marshes behind a sand bar.
Principal vegetation: Mangrove swamps with *Avicennia germinans, Laguncularia racemosa, Conocarpus erectus* and *Rhizophora mangle*; some *Typha domingensis*.

Land tenure: Owned by the Petroleum Corporation of Jamaica.
Protection: No legal protection; a designated Conservation Area in the Parish Development Order.
Land use: Fishing, harvesting of crabs and hunting of Columbidae; agriculture nearby.
Waterfowl: *Pelecanus occidentalis* and *Egretta alba* occur.
Other fauna: The wetland supports a significant population of the American Crocodile *Crocodylus acutus*.
Threats: Fishermen kill crocodiles as competitors for fish stocks, and some crocodiles are drowned in fishing nets. There is some hunting of sea turtles and collection of their eggs.
Research and conservation: The wetland and adjacent coastline have been delineated by the Natural Resource Conservation Department for protection by the Petroleum Corporation of Jamaica as a sanctuary for crocodiles and other fauna. A crocodile tagging project is in operation at Luana, Black River and Parottee.
Source: Aquatic Resources Division, Natural Resource Conservation Department.
Criteria for inclusion: 2a & 3a.

Black River Lower Morass (3)

Location: 18°03'N, 77°48'W; northeast of Black River town, St. Elizabeth Parish.
Area: 5,700 ha.
Altitude: 0m.
Province and type: 8.40.13; 06, 07, 08, 13, 16, 18 & 19.
Site description: A complex of shallow brackish lagoons, tidal marshes, mudflats and mangroves near the coast; and extensive freshwater marshes with peat formations 3-7m deep, seasonally flooded grassland and swamp forest along the lower Black River. Salinities range from 1-20 p.p.t., and there are slight tidal fluctuations in water level near the coast. The morass comprises an interesting estuarine system in which salt water underlies fresh water for some kilometres inland.
Principal vegetation: Coastal and riverine mangrove swamps, principally *Rhizophora mangle*; extensive marshes with *Typha domingensis, Cladium jamaicensis* and, in drier parts, *Sabal jamaicensis*; and swamp forest. The vegetation has been described in detail by Bjork (1983).
Land tenure: Owned partly by the state and partly by the Petroleum Corporation of Jamaica.
Protection: No legal protection; a designated Conservation Area in the Parish Development Order, and a proposed inland conservation area in the National Physical Plan.
Land use: Fishing, harvesting of shrimps, exploitation of mangroves for the production of tannin, and reed-cutting for basket-making. Agriculture in surrounding areas. Approximately 1,000 people use the wetland for fishing and shrimping, and for many, this is their only means of livelihood.
Waterfowl: A very important breeding area for many waterfowl, and the last stronghold of several species in Jamaica, notably *Dendrocygna arborea* (hundreds), *Aramus guarauna* (tens), and *Laterallus jamaicensis* (rare). Other breeding species include *Podilymbus podiceps, Ixobrychus exilis, Nycticorax nycticorax, Bubulcus ibis* (thousands), *Butorides virescens, Oxyura dominica, Rallus longirostris, R. maculatus, Porzana flaviventer, Gallinula chloropus, Porphyrula martinica, Jacana spinosa* and *Charadrius vociferus*. Common non-breeding visitors include a variety of Ardeidae, *Plegadis falcinellus, Anas discors, Porzana carolina, Fulica americana, Actitis macularia, Gallinago gallinago* and *Himantopus himantopus*.
Other fauna: *Pandion haliaetus, Circus cyaneus* and *Falco peregrinus* are winter visitors, and *Crocodylus acutus* occurs. The wetland is an important breeding ground and nursery for commercially important fishes such as *Lutjanus apodus, Megalops atlantica* and *Caranx latus*, and the shrimps *Macrobrachium acanthurus* and *M. faustinum*.
Threats: Large-scale drainage of the Black River Upper Morass has had some detrimental effects on the Lower Morass, and there is some pollution from industrial waste. There is also a project to plant rice in extensive areas of shallower peat. The most serious threat, however, is a proposal of the Petroleum Corporation of Jamaica to mine the peat resources for fuel. Although it has been argued that mining activities could enhance the value of the wetland for some wildlife species, e.g Anatidae, the unique and as yet relatively undisturbed natural ecosystems would be seriously disrupted.

Research and conservation: A number of studies on the feasibility and environmental impact of peat mining have been carried out by the Petroleum Corporation of Jamaica, the Natural Resource Conservation Department and the University of Lund, Sweden. Whether or not the area will be mined is still under debate. The peat resources are inferior to those of Negril Morass (site 1), and the wetland is much more important, both in terms of its native fauna and flora and its commercially important fisheries. If properly managed as a Wildlife Park, the wetland could support a wide range of recreational activities with minimum disturbance to the ecosystems. In 1984, it was proposed that parts of the Morass not suitable for peat mining or rice production should be managed by NRCD as a Conservation Area.
References: Crontmij (1964); Natural Resource Conservation Department & Traverse Group, Inc. (1981); Bjork (1982, 1983 & 1984); Coke *et al* (1982); Cronberg (1983); Fritzon (1983); Svensson (1983); Digerfeldt & Enell (1984); Enell (1984).
Source: Robert L. Sutton and Aquatic Resources Division, Natural Resource Conservation Department.
Criteria for inclusion: 123.

Parottee Salt Pond (4)

Location: 17°58'N, 77°50'W; 7 km southeast of Black River, St. Elizabeth Parish.
Area: 190 ha.
Altitude: 0m.
Province and type: 8.40.13; 06, 07 & 08.
Site description: A complex of shallow saline lagoons, up to 3m deep, surrounded by mudflats and patches of mangrove swamp; formerly connected to the sea but recently cut off by road construction. Salinities range from 29-48 p.p.t. As much as two-thirds of the wetland dries out during the dry season.
Principal vegetation: Mangrove swamps.
Land tenure: A mixture of state and private ownership.
Protection: None.
Land use: Fishing, cutting of mangroves for fuel, and livestock grazing.
Waterfowl: One of the richest wetlands in Jamaica for waterfowl, with a great diversity of breeding, passage and wintering species (62 species recorded). Breeding birds include *Pelecanus occidentalis, Ixobrychus exilis, Nyctanassa violacea, Egretta caerulea, E. tricolor, E. thula, E. alba, Dendrocygna arborea, Rallus longirostris, Porphyrula martinica, Charadrius wilsonius, Himantopus himantopus* and *Sterna albifrons*. Passage migrants and winter visitors include *Anas discors* (hundreds), *A. crecca, A. americana, A. clypeata* and *Oxyura jamaicensis* in small numbers, *Porzana carolina, Fulica americana* (hundreds), many shorebirds, notably *Charadrius semipalmatus, Tringa melanoleuca, T. flavipes, Calidris minutilla* and *Micropalama himantopus*, and a variety of Laridae.
Other fauna: *Pandion haliaetus, Falco peregrinus* and *F. columbarius* are winter visitors. The area is excellent habitat for the American Crocodile *Crocodylus acutus*.
Threats: The main threat is a plan by private developers to drain large portions of the wetland for housing development.
Research and conservation: The avifauna of the area is relatively well known. The wetland has great potential for nature tourism and could make an excellent wildlife reserve. However, the lagoon must be reconnected to the sea to ensure the survival of the mangrove swamps. It has recently been proposed that the lagoon be allocated to NRCD and managed as part of a Black River Conservation Area.
References: Svensson (1983).
Source: Robert L. Sutton.
Criteria for inclusion: 2a, 2b & 3a.

Great Pedro Pond (5)

Location: 17°52'N, 77°45'W; near Treasure Bay, St. Elizabeth Parish.
Area: 20 ha.
Altitude: 0m.
Province and type: 8.40.13; 07.
Site description: A shallow saline coastal lagoon with fringing mudflats. The salinity ranges from 15-35 p.p.t., and the water level fluctuates widely, the lagoon drying out completely in some years.
Principal vegetation: Almost no vegetation.
Land tenure: Privately owned.
Protection: No legal protection; a designated Conservation Area in the Parish Development Order.
Land use: Fishing and illegal duck hunting; livestock grazing in surrounding areas.
Waterfowl: An important feeding area for resident species, particularly Ardeidae, and passage and wintering area for Nearctic Anatidae, shorebirds and Laridae. Over 40 species of waterfowl have been recorded. The commoner species include *Podilymbus podiceps* (hundreds), *Podiceps dominicus, Pelecanus occidentalis, Egretta caerulea, E. tricolor, E. thula, E. alba, Ardea herodias, Anas discors* (hundreds), *Oxyura dominica, Fulica americana* (hundreds), *Pluvialis squatarola, Charadrius semipalmatus, C. vociferus, Tringa melanoleuca, T. flavipes, Arenaria interpres* and *Calidris minutilla. Sterna albifrons* breeds, and *Egretta rufescens*
is a regular winter visitor in small numbers.
Other fauna: *Pandion haliaetus, Falco peregrinus* and *F. columbarius* occur in winter. Up to three American Crocodiles *Crocodylus acutus* have been seen in the lagoon, but they are not resident.
Threats: The lagoon is under no immediate threat, but housing development nearby may eventually have a serious effect on the wetland.
Research and conservation: The Natural Resource Conservation Department has proposed that the area be protected, and this has met with opposition from only one of the adjoining land owners.
References: Svensson (1983).
Source: Robert L. Sutton and Aquatic Resources Division, Natural Resource Conservation Department.
Criteria for inclusion: 3a.

Canoe Valley (6)

Location: 17°52'N, 77°25'W; east of Alligator Pond, Manchester County.
Area: 625 ha.
Altitude: 0m.
Province and type: 8.40.13; 05, 07 & 08.
Site description: A chain of shallow brackish marshes and mangrove swamps behind a coastal sand bar; fed by a series of springs upwelling from the base of a limestone hill to the north. Salinities range from 1-10 p.p.t.
Principal vegetation: Mangrove swamps with *Avicennia germinans* and *Conocarpus erectus*; brackish marshes with *Typha domingensis* and *Cladium jamaicensis.*
Land tenure: State owned.
Protection: No legal protection; a designated Conservation Area in the Parish Development Order, and a proposed National Park in the National Physical Plan.
Land use: Fishing and reed-cutting for basket-making.
Waterfowl: No detailed information is available. The commoner species include *Podilymbus podiceps, Pelecanus occidentalis* (breeding colony), *Bubulcus ibis* (breeding colony), *Egretta caerulea, E. tricolor, E. thula, Ardea herodias, Gallinula chloropus, Jacana spinosa* and a variety of shorebirds.
Other fauna: A few manatees *Trichechus manatus* and American Crocodiles *Crocodylus acutus* occur in the marshes, and sea turtles occur along the beach.

Threats: The wetland is under no immediate threat, but road development and charcoal production are causing some problems.
Research and conservation: The Natural Resource Conservation Department carried out an ecological study of the wetland in 1975, and is currently conducting a manatee research and management project (Operation Sea Cow). A Government proposal exists for the protection and development of the site as a National Park, and it is already being developed as an educational and recreational facility, with some funding from the O.A.S.
Source: Aquatic Resources Division, Natural Resource Conservation Department.
Criteria for inclusion: 2a & 3a.

Portland Bight Swamp (West Harbour) (7)

Location: 17°47'N, 77°11'W; southeast of Lionel Town, Clarendon Parish.
Area: 2,083 ha.
Altitude: 0m.
Province and type: 8.40.13; 01, 03, 07 & 08.
Site description: A shallow sea bay with mangrove covered islands and mangrove fringe; a large saline lagoon, up to 4m deep, behind the mangrove fringe; and some brackish marshes in the north. Salinities range from 34-40 p.p.t., and tidal variation in the bay ranges from 36-40 cm. The wetland contains the best mangrove development in Jamaica.
Principal vegetation: Mangrove swamps with *Avicennia germinans*, *Laguncularia racemosa* and *Rhizophora mangle*; brackish marshes with *Typha* sp and *Phragmites* sp.
Land tenure: State owned.
Protection: No legal protection. A designated Conservation Area in the Parish Development Order, and a proposed National Park in the National Physical Plan; the local Gun Club closes off the wetland to public access during the bird hunting season.
Land use: Sport and commercial fishing, crab fishing, sport hunting (mainly for Columbidae), cutting of mangroves for timber and to produce tannin for curing hides, and scientific research.
Waterfowl: Known to be an important area for waterfowl, but few data are available. Species recorded include *Nycticorax nycticorax*, *Egretta caerulea*, *E. rufescens*, *Ardea herodias*, *Eudocimus albus*, *Aramus guarauna*, many Nearctic shorebirds, *Himantopus himantopus* and *Sterna albifrons*.
Other fauna: *Pandion haliaetus* occurs in winter. There is an extremely rich marine fauna associated with the mangrove swamps.
Threats: The main threats are reclamation of land for industry and indiscriminate felling of mangroves. There is some oil pollution from passing shipping, and excessive hunting may be affecting some waterfowl populations.
Research and conservation: A considerable amount of research has been conducted in the wetland, particularly by students from the University of the West Indies in Kingston. B.A. Wade has studied oil pollution in the bay, and B. Chow has recently completed an evaluation of the importance of the wetlands to the economy of the region. The Natural Resource Conservation Department is developing a management plan, and the wetland has been included in a proposed "Portland Ridge and Bight National Park (Marine Park)".
References: Wade (1974); Chow (in prep).
Source: Aquatic Resources Division, Natural Resource Conservation Department.
Criteria for inclusion: 2b & 3a.

Cockpit - Salt River Swamp (8)

Location: 17°50'N, 77°10'W; east of Salt River, Clarendon Parish.
Area: 166 ha.
Altitude: 0m.
Province and type: 8.40.13; 07, 08 & 13.

Site description: A freshwater swamp fed by numerous springs, flowing into a salt water creek with mangrove swamps behind a sea beach. Salinities range from fresh to 35 p.p.t.; and there is some tidal influence near the coast. An irrigation canal originates in the north of the swamp and flows the full length of it.
Principal vegetation: Mangrove swamps with *Avicennia germinans* and *Rhizophora mangle*; freshwater marshes with *Typha domingensis* and *Nasturtium officinale.*
Land tenure: State owned.
Protection: No legal protection; a designated Conservation Area in the Parish Development Order.
Land use: Fishing.
Waterfowl: No information.
Other fauna: The American Crocodile *Crocodylus acutus* occurs.
Threats: A proposal has been made to drain the swamp for real estate development.
Research and conservation: The coastal fringe of mangroves should be preserved for coastal protection, and the entire area could be developed as a small National Park offering a variety of forms of outdoor recreation.
References: Wade *et al* (1972).
Source: Aquatic Resources Division, Natural Resource Conservation Department.
Criteria for inclusion: 2a & 3a.

Hellshire - Cabarita Swamp (9)

Location: 17°53'N, 77°04'W; southeast of Old Harbour, St. Catherine Parish.
Area: 666 ha.
Altitude: 0m.
Province and type: 8.40.13; 05, 06, 07 & 08.
Site description: A group of permanent shallow brackish lagoons behind a sand bar, with tidal mudflats and mangrove swamps. Some of the lagoons are connected to the sea by narrow channels and are subject to tidal influence. Salinities range from 25-30 p.p.t.
Principal vegetation: Mangrove swamps, mainly *Rhizophora mangle* with some *Avicennia germinans, Conocarpus erectus* and *Thespesia populnea.*
Land tenure: State owned.
Protection: No legal protection; a designated Conservation Area in the Parish Development Order.
Land use: Fishing.
Waterfowl: Known to be an important area for waterfowl, particularly migrant shorebirds, but no details are available.
Other fauna: An important spawning ground for the Bone Fish *Albula vulpes.* The adjacent coastal waters are important for *Trichechus manatus* and sea turtles.
Threats: None known.
Research and conservation: The wetland remains poorly known despite its proximity to Kingston. However, the Zoology Department of the University of the West Indies is beginning an ecological study of the wetland in January 1985. The area would be suitable for the establishment of a National Park.
Source: Aquatic Resources Division, Natural Resource Conservation Department.
Criteria for inclusion: 0.

Great Salt Pond and Flashes (10)

Location: 17°58'N, 76°52'W; southeast of Spanish Town, St. Catherine Parish.
Area: 186 ha.
Altitude: 0m.
Province and type: 8.40.13; 05, 07 & 08.

Site description: A saline coastal lagoon, up to 3m deep, behind a sand bar, with brackish marshes (flashes) and mangrove swamps. The lagoon has now been permanently opened to the sea. Salinities range from 16-74 p.p.t.
Principal vegetation: Mangrove swamps, mainly *Rhizophora mangle* with some *Conocarpus erectus*; brackish marshes with *Typha domingensis* and *Cladium jamaicensis.*
Land tenure: State owned.
Protection: No legal protection; a designated Conservation Area in the Parish Development Order.
Land use: Fishing and recreation. There is a proposal to use the lagoon for shrimp farming.
Waterfowl: No information.
Other fauna: The American Crocodile *Crocodylus acutus* occurs.
Threats: There is some pollution in the lagoon, and the Urban Development Corporation has proposed a scheme to take water from the aquifer supplying the wetland to Hellshire New Town.
Research and conservation: The ecology of the wetland has been studied by an MSc student of the University of the West Indies. The site would be ideal for a small park as it has the nearest white sand beach to Kingston and is a popular recreation area.
Source: Aquatic Resources Division, Natural Resource Conservation Department.
Criteria for inclusion: 2a & 3a.

Port Royal Swamps (11)

Location: 17°57'N, 76°49'W; east of Port Royal, Kingston.
Area: 20 ha.
Altitude: 0m.
Province and type: 8.40.13; 05 & 08.
Site description: A mangrove swamp subject to tidal influence, behind a sea beach. Salinities range from 25-35 p.p.t.
Principal vegetation: Mangrove swamps with *Avicennia germinans, Laguncularia racemosa, Conocarpus erectus* and *Rhizophora mangle.*
Land tenure: State owned.
Protection: No legal protection, but protected to some extent by the Marine Laboratory of the University of the West Indies. A designated Conservation Area in the Parish Development Order.
Land use: Fishing.
Waterfowl: An important area for waterfowl, but few data are available. *Eudocimus albus* is reported to have nested.
Other fauna: No information.
Threats: There is a considerable amount of pollution from oil spills in Kingston Harbour, and there are plans to use the area for extensions to the nearby airport and marina. Proposals for the expansion of Port Royal also pose a threat.
Research and conservation: The mangrove swamp lies very close to the Marine Laboratory of the University of the West Indies and is used for teaching purposes. It is also part of a proposed National Park.
Source: Aquatic Resources Division, Natural Resource Conservation Department.
Criteria for inclusion: 3a.

The Great Morass (12)

Location: 17°55'N, 76°14'W; east of Port Morant, St. Thomas Parish.
Area: 1,660 ha.
Altitude: 0m.
Province and type: 8.40.13; 05 & 08.

Site description: A mangrove swamp subject to tidal influence, behind a sea beach. Salinities range from 25-35 p.p.t.
Principal vegetation: Mangrove swamps with *Avicennia germinans, Laguncularia racemosa, Conocarpus erectus* and *Rhizophora mangle.*
Land tenure: A mixture of state and private ownership.
Protection: No legal protection; a designated Conservation Area in the Parish Development Order.
Land use: Fishing; agriculture in surrounding areas.
Waterfowl: No information.
Other fauna: The American Crocodile *Crocodylus acutus* occurs in the area; sea turtles are known to use the beaches for nesting; and the swamp is an important nursery ground for marine fishes.
Threats: A part of the swamp has already be drained for agriculture, and further drainage is likely to occur.
Research and conservation: The area is a proposed National Park, and has potential value for aquaculture.
Source: Aquatic Resources Division, Natural Resource Conservation Department.
Criteria for inclusion: 2a, 2c & 3a.

Turtle Crawle Swamp (13)

Location: 18°11'N, 76°25'W; east of Port Antonio, Portland Parish.
Area: 25 ha.
Altitude: 0m.
Province and type: 8.40.13; 05, 07, 08 & 13.
Site description: A mangrove swamp and tidal marshes behind a sea beach, and adjacent fresh to brackish marshes.
Principal vegetation: Mangrove swamps with *Avicennia germinans, Laguncularia racemosa* and *Rhizophora mangle*; marshes with *Typha domingensis*, sedges and grasses.
Land tenure: Privately owned.
Protection: No legal protection; a designated Conservation Area in the Parish Development Order.
Land use: Fishing and harvesting of shrimps.
Waterfowl: No information.
Other fauna: The swamp constitutes a small nursery ground for shrimps and 17 species of commercially important fishes.
Threats: There is a proposal to reclaim the swamp for housing development, and some landfill has already been established at the western extremity.
Source: Aquatic Resources Division, Natural Resource Conservation Department.
Criteria for inclusion: 2c & 3a.

Pear Tree Swamp (14)

Location: 18°27'N, 77°21'W; east of Runaway Bay, St. Ann Parish.
Area: 16 ha.
Altitude: 0m.
Province and type: 8.40.13; 05 & 13.
Site description: A small spring-fed freshwater marsh with clear pools (blue holes) up to 2m deep; behind a sea beach. The last remaining freshwater swamp of its kind in Jamaica.
Principal vegetation: *Typha domingensis* and *Acrostichum aureum.*
Land tenure: State owned.
Protection: No legal protection; a designated Conservation Area in the Parish Development Order.
Land use: Fishing and harvesting of shrimps.
Waterfowl: No information.
Other fauna: No information.

Threats: None known.
Research and conservation: Although now unique in Jamaica, the swamp has apparently never been studied. It is clearly of great scientific interest, and merits full protection.
Source: Aquatic Resources Division, Natural Resource Conservation Department.
Criteria for inclusion: 2b & 3b.

Hague and Bush Cay Swamps (15)

Location: 18°30'N, 77°40'W; around Falmouth, Trelawny Parish.
Area: 118 ha.
Altitude: 0m.
Province and type: 8.40.13; 02, 07 & 08.
Site description: A brackish coastal lagoon, up to 6m deep, brackish marshes and extensive mangrove swamps at the mouth of the Martha Brae River; subject to small tidal fluctuations. Salinities range from 1-20 p.p.t.
Principal vegetation: *Rhizophora mangle* and *Acrostichum aureum.*
Land tenure: A mixture of state and private ownership.
Protection: The mangroves are covered by a Tree Preservation Order dated 1967, and the site is a designated Conservation Area in the Parish Development Order.
Land use: Fishing, rafting on the river, and cutting of mangroves for charcoal production.
Waterfowl: Little information is available; there is a breeding colony of *Bubulcus ibis*, and *Egretta caerulea* occurs.
Other fauna: There is a small population of the American Crocodile *Crocodylus acutus* which is thought to have been introduced in recent times as a tourist attraction. Before the commencement of land reclamation schemes, the lagoon had one of the highest concentrations of luminescent organisms known, and was a popular tourist attraction.
Threats: Parts of the marshes have been reclaimed for rice cultivation and real estate development. This destruction of wetland habitat continues as the town of Falmouth expands.
Research and conservation: Johns Hopkins University has conducted research on the bioluminescence in the lagoon. The luminescent organisms have largely disappeared as a result of habitat destruction, but it is thought that with appropriate management, the ecosystem could be restored and this interesting biological phenomenon revived.
References: Seliger & Fastie (1967); Seliger & McElroy (1967).
Source: Aquatic Resources Division, Natural Resource Conservation Department.
Criteria for inclusion: 3b.

MONTSERRAT

INTRODUCTION

by **Dennis Gibbs**

Montserrat is a small forested volcanic island of about 98 km^2 in extent in the northern Windward Islands in the Caribbean Sea. It is a British Colony and has a population of about 12,000 with an economy based on holiday villa tourism and some agriculture. There are very few wetlands; only two patches of coastal mangroves, a number of mountain streams, and a few tiny ponds and marshes. There are, however, rich marine resources around the island and nesting beaches for several species of sea turtle.

The conservation body is the Montserrat National Trust, a non-governmental, non-profit volunteer statutory body concerned with all aspects of conservation, cultural as well as those dealing with fauna and flora.

One of the two most important wetlands on the island was protected in 1979 (Fox's Bay Bird Sanctuary), and the other, Belham River Estuary, has been declared a no hunting zone by the owners.

The Wild Birds Protection Ordinance as revised in 1982 gives full protection to all bird species except for two species of pigeon Columbidae and the ducks Anatidae. A further revision of the ordinance is expected soon.

The birds of Montserrat have recently been described by Siegel (1983), and in July 1984, W. Arendt conducted a survey of the breeding population of the Cattle Egret *Bubulcus ibis*.

WETLANDS

Site descriptions based on data sheets provided by Dennis Gibbs of the Montserrat National Trust. (For map, see Dominica.)

Fox's Bay Bird Sanctuary (1)

Location: 16°41'N, 62°13'W; on the west coast, 2 km northwest of Plymouth
Area: 6 ha.
Altitude: 0m.
Province and type: 8.41.13; 05, 07 & 08.
Site description: A coastal brackish pond, up to 3m deep, and mangrove swamp, with adjacent sandy beaches. The water level drops considerably during the dry season.
Principal vegetation: Mangrove swamps with *Laguncularia racemosa, Conocarpus erectus* and *Rhizophora mangle*, brackish marshes with *Eleocharis geniculata* and *Acrostichum aureum*, and coastal thorn forest.
Land tenure: Owned by the Montserrat Company, and on a twenty year lease to the Montserrat National Trust.
Protection: A Protected Wildlife Area established by the Montserrat National Trust in 1979, and administered as a bird sanctuary.
Land use: Nature tourism and some livestock grazing. Access to the interior of the swamp has been made relatively easy by means of marked trails.
Waterfowl: An important breeding area for many of Montserrat's resident species, and a wintering area for migratory Ardeidae and shorebirds. The main nesting site on the island for *Bubulcus ibis*, with a population of over 1,000 birds. Other breeding species include *Nyctanassa violacea, Butorides virescens, Gallinula chloropus* and *Fulica caribaea.* Regular winter visitors include *Egretta caerulea, Ardea herodias, Porzana carolina, Tringa melanoleuca, T. flavipes, Actitis macularia* and *Larus atricilla*
Other fauna: An important wintering area for North American warblers Parulidae. A breeding area for the sea turtles *Caretta caretta, Chelonia mydas, Dermochelys coriacea* and *Eretmochelys imbricata.* Other species recorded include *Bufo marinus, Eleutherodactylus johnstonei, Ameiva pluvianotata pluvianotata, Anolis lividus, Iguana iguana, Mabuya mabouya mabouya, Shaerodactyla fantasticus, Alsophis antillensis manselli, Artibens jamaicensis* and *Molossus molossus.*
Threats: There are some problems with overgrazing by domestic livestock and siltation.
Research and conservation: The avifauna is well known, and has recently been described by Siegel. W. Arendt conducted a survey of the *Bubulcus ibis* colony in July 1984. The sanctuary should be fenced to prevent intrusion by domestic livestock, and the possibility of pumping water into the swamp to prevent drying out during the dry season might be considered.
References: Siegel (1983); Portecop & Benito-Espinal (1984a).
Source: Dennis Gibbs.
Criteria for inclusion: 2a, 2b & 3a.

Belham River Estuary (2)

Location: 16°44'N, 62°14'W; on the west coast, 6 km northwest of Plymouth.
Area: 14 ha.
Altitude: 0m.
Province and type: 8.41.13; 02, 05, 10 & 11.
Site description: The estuary and lower stretches of the Belham River, with a series of small freshwater ponds and marshes, and sandy beaches at the river mouth. The river rises at a spring at 300m and falls rapidly to the coastal plain. The water level fluctuates according to local rainfall.
Principal vegetation: Thorn woodland, moist broadleaf forest, bamboos and grassland in surrounding areas.

Land tenure: Owned by the Montserrat Company and one private owner, and leased by the Montserrat Golf Club.
Protection: No habitat protection, but hunting is prohibited.
Land use: Part of the area is on a golf course; there is some grazing of domestic livestock, occasional turtle hunting on the beaches, and beach resort activities.
Waterfowl: A feeding area for resident waterfowl and a stop-over for migratory Anatidae and shorebirds, including *Gallinago gallinago. Tringa melanoleuca, T. flavipes* and *Actitis macularia* overwinter.
Other fauna: Similar to site 1, but with the addition of a variety of freshwater crustaceans and fishes.
Threats: The main threat is the possibility that measures might be taken to reduce flows by further encatchment of springs. This would affect the wetland habitat in the dry season, but rejuvenation by wet season flood waters would still occur. There is also some illegal grazing of domestic livestock.
Source: Dennis Gibbs.
Criteria for inclusion: 2b & 3a.

NETHERLANDS ANTILLES

INTRODUCTION

by **Bart A. de Boer**

The six islands of the Netherlands Antilles consist of a group of three "Leeward" islands (Aruba, Bonaire and Curacao) and three "Windward" islands (Saba, Sint Eustatius and Sint Maarten). The total area of the six islands is approximately 992 km^2. The two groups are about 900 km apart and show considerable differences in flora and fauna.

The Leeward group lies about 80 km off the coast of Venezuela, between 11°N and 12°N, and between 68°W and 70°W. The climate is semi-arid, characterized by low precipitation (annual mean on Curacao 560 mm) and high temperatures (annual mean 27°C). The main rainy season is reported to be from October to January and the lesser rainy season in May, but heavy rainfall may occur outside these periods, while the supposedly rainy months may remain dry. The vegetation consists mainly of xerophytic shrubs and cacti. There is little agriculture but goats are abundant and cause considerable damage to the vegetation. The demands on land for housing construction are becoming increasingly great. Curacao is the most densely populated of the three islands (160,000 inhabitants), followed by Aruba (60,000) then Bonaire (8,000). The fauna is a mixture of Caribbean and continental South American. In winter, migrant birds from both North and South America may visit the islands.

The Windward group lies about 250 km east of Puerto Rico, at approximately 17-18°N and 63°W. Rainfall is twice as high as in the Leeward group, and the rainy season, November, is more sharply defined. The annual mean temperature is 26.8°C. In the lowlands, the vegetation has a semi-arid appearance but high in the hills, dense woodlands occur. The islands lie in the hurricane belt. There is little agriculture but here also goats cause extensive damage. St. Maarten is divided into a Dutch and a French part. In the Dutch part, much of the landscape has been damaged by the construction of hotels and villas. The population of the three islands is about 20,000 (St. Maarten 17,500; St. Eustatius 1,500; and Saba 1,000). The fauna of this group is typically Caribbean, with a number of Nearctic migrants occurring on passage and in winter.

There are few wetlands in the Netherlands Antilles. Saba and St Eustatius have none at all, and on Curacao only some small inner bays bordered by mangroves are of any significance. Aruba has a number of reef islands which are important breeding sites for several species of terns Laridae including the Cayenne Tern *Sterna sandvicensis eurygnatha.* Another important site is a freshwater sewage pond (Bubali Pond) with herons and egrets Ardeidae, grebes Podicipedidae, pelicans Pelecanidae, cormorants Phalacrocoracidae and coots Rallidae. Bonaire is famous for its flamingo breeding colony in the midst of a large solar salt industrial complex. The borders of the Lac, a large shallow sea bay, have a dense mangrove fringe which supports numerous herons and egrets. The lakes Goto and Slagbaai, both situated in the Washington-Slagbaai National Park, are highly saline lagoons with good feeding habitat for numerous shorebirds. St. Maarten possesses a few large saline lagoons and various smaller freshwater ponds. There is some good but rather disturbed feeding habitat for herons, egrets, ducks and shorebirds, but few birds breed. Some small cays off the coast provide nesting habitat for the terns *Sterna anaethetus, S. fuscata* and *Anous stolidus*, Laughing Gull *Larus atricilla*, and the tropic-birds *Phaethon aethereus* and *P. lepturus.*

In all, sixty-five species of waterfowl have occurred in the islands; twenty breed, twenty-eight occur as winter visitors, and seventeen occur on migration or as vagrants. Of the breeding species, the Caribbean Flamingo *Phoenicopterus ruber ruber* has received the most attention. The flamingo sanctuary on Bonaire constitutes the main if not the only breeding site for the entire south Caribbean population of some 17,000 to 18,000 birds. In years of high rainfall, 3,000 - 4,000 pairs may nest on Bonaire. Outside the breeding season, about 1,000 birds remain on the island. Changes in water flow have had an adverse effect on the food species of the flamingos in the salt pans, and the number of birds feeding in the industrial complex has decreased in recent years.

The local race of the Striated Heron *Butorides virescens curacensis* is the only endemic subspecies of waterfowl in the Netherlands Antilles. It is restricted to the islands of Aruba, Bonaire and Curacao, where it is fairly common. However, there seems to be some interbreeding with birds of the nominate race from South America as adult birds with intermediate plumage have been collected.

Shorebirds are found throughout the islands along the shores of the numerous bays and saline lagoons. In winter, their numbers are swelled considerably with the arrival of migrants from North America. Because of the lack of extensive freshwater habitats, species dependent on these, such as ducks, coots and rails are scarce, and their occurrence is dependent on the presence of temporary pools after heavy rains.

Institutional Base for Wetland Conservation and Research

The organization concerned with conservation in the Netherlands Antilles is the Netherlands Antilles National Parks Foundation (Stichting Nationale Parken Nederlandse Antillen - STINAPA), with its headquarters in Curacao. The research organization is the Caribbean Ecological Institute (Caraibisch Marien-Biologisch Instituut - CARMABI), also in Curacao. Both organizations are non-governmental, although CARMABI is heavily dependent on governmental funding.

Progress in Wetland Conservation and Research

No special legislation exists nor does any programme exist concerning the conservation of wetlands. However, several areas have been designated as bird sanctuaries. On Aruba, the Bubali Pond has been declared a bird sanctuary; on Bonaire, 55 ha in the industrial salt complex were declared a bird sanctuary in 1969, and Slagbaai and Gotomeer are included within the Washington-Slagbaai National Park, established in 1969. As a Contracting Party to the Ramsar Convention, the Dutch Government has designated six sites in the Netherlands Antilles (Lac, Pekelmeer, Little Bonaire, Gotomeer, Slagbaai and Spaans Lagoon) for inclusion in the List of Wetlands of International Importance.

There is no legal exploitation of waterfowl in the Netherlands Antilles, but some illegal egg-collecting for consumption occurs at the tern colonies on Aruba.

Almost all waterfowl research has centred on the flamingo population on Bonaire. This has been the subject of two major investigations. J. Rooth investigated habitat, diet and reproduction of the flamingos in 1959/60, and the author conducted research on the food situation, breeding success and habitat on Bonaire and in Venezuela from 1975 to 1980 (partly a WWF project).

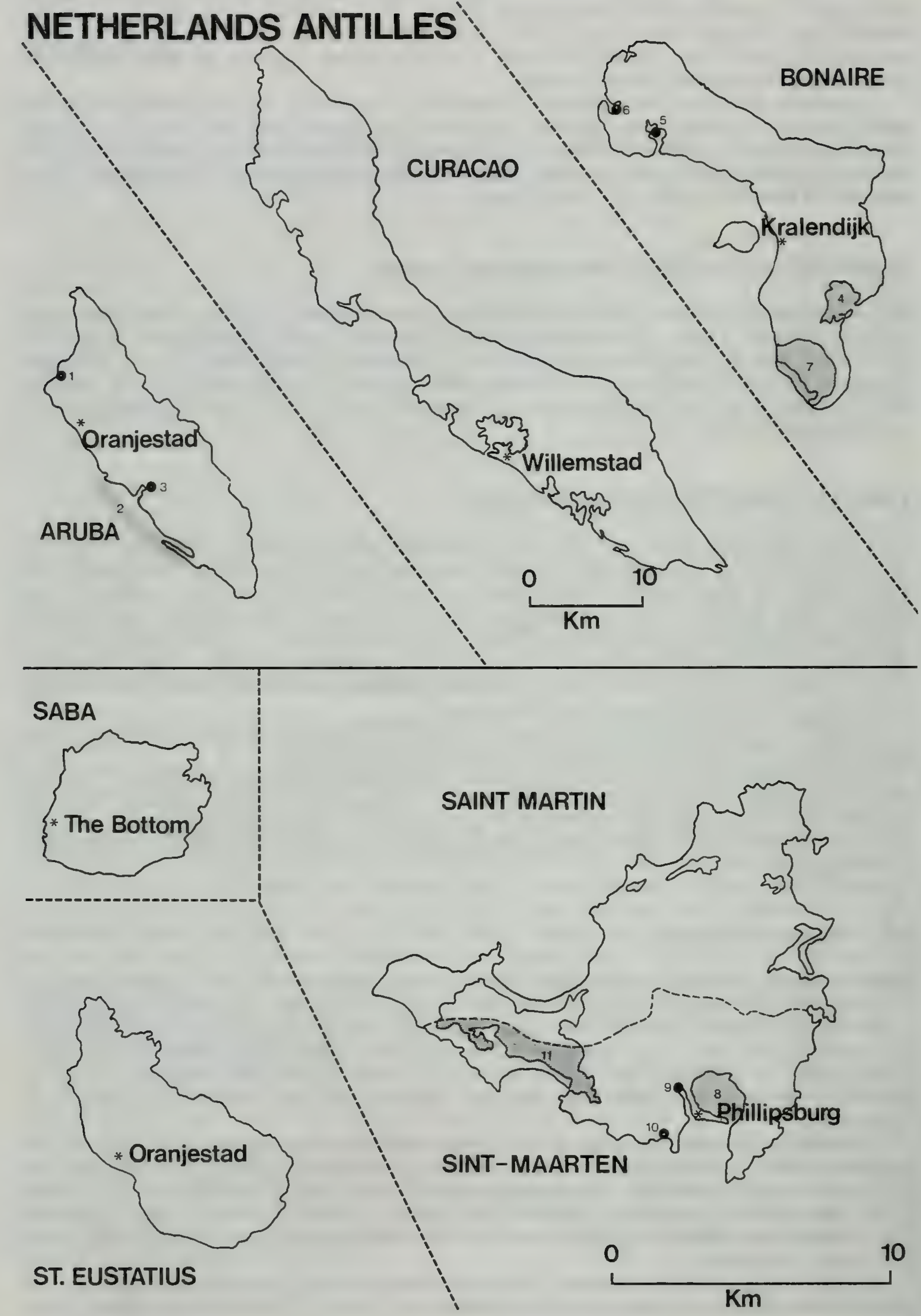
Major Threats to Wetlands

While the threats to wetlands differ somewhat from island to island, the main threat throughout is the destruction of habitat in land development projects for tourism, agriculture and industry.

On Aruba, Bubali Pond gets its water from the sewage outlet of several big hotels. Government plans exist to use this water for agricultural projects, cutting off the water supply to the pond. One of the reef islands on which *Sterna sandvicensis eurygnatha* breeds is polluted by oil from the nearby Lago Refinery. This refinery will, however, close down in March 1985.

On Bonaire, a holiday village is being built near the Lac wetland and parts of the mangroves have been destroyed. In the industrial salt complex, gypsum is settling on the bottoms of the salt condensers. The flamingos are no longer able to get to the brine fly larvae in the mud and have switched to a diet of small snails. It is not clear if the snail population can withstand this predation pressure, and it may be that the flamingos will lose their main food supply on Bonaire.

On the Dutch part of St. Maarten, all the wetlands are being seriously threatened by the rapidly developing tourist industry and the vegetation of most of the lagoons has already been badly damaged.


NETHERLANDS ANTILLES
ARUBA
Oranjestad
1
2
3
CURACAO
Willemstad
BONAIRE
Kralendijk
4
5
6
7
0
10
Km
SABA
The Bottom
ST. EUSTATIUS
Oranjestad
SAINT MARTIN
SINT-MAARTEN
Phillipsburg
8
9
10
11
0
10
Km

WETLANDS

Site descriptions based on data sheets provided by Bart A. de Boer, Vera Rooze and J. Vliegen.

Bubali Pond (1)

Location: 12°34'N, 70°03'W; 5 km north of Oranjestad, Aruba.
Area: 30 ha.
Altitude: 0m.
Province and type: 8.17.4; 07 & 08.
Site description: A shallow slightly brackish lake, up to 1m deep, and brackish marshes created by the discharge of purified domestic sewage into a former saline lagoon; with some mangroves. Salinities range from less than 1 p.p.t. in the lake to 5.8 p.p.t. in the marshes to the east of the lake. The water level fluctuates according to the discharge of sewage, and parts of the marshes in the east dry out in summer.
Principal vegetation: Mangrove swamps with *Avicennia germinans* and *Conocarpus erectus*; marshes with *Typha domingensis* and *Batis maritima.*
Land tenure: Owned by the Island Government of Aruba.
Protection: Declared a Sanctuary, but no special protection measures have been implemented.
Land use: Occasional illegal hunting. There is a hotel and residential area nearby.
Waterfowl: A wide variety of waterfowl have been recorded, particularly Ardeidae and migrant shorebirds. Peak counts have included *200 Nycticorax nycticorax, 200 Egretta thula, 50 E. alba, 50 Ardea herodias, 200 Anas discors* and 100 *Charadrius vociferus.* The area is especially noteworthy for the number of species which occur as occasional passage migrants, but which are rare elsewhere in the islands, e.g. *Plegadis falcinellus, P. chihi, Eudocimus albus* and *Rynchops niger.*
Other fauna: No information.
Threats: The water supply may be cut off in future as the Government is considering using the treated sewage for agricultural projects. Eutrophication and siltation are causing some problems, and botulism has occurred. A few cases were suspected in 1980 and 1981, but there have been no major outbreaks. There is some illegal hunting of birds and iguanas, and feral dogs destroy some birds' nests.
Research and conservation: Bubali Pond is the only brackish lake in the southern group of the Netherlands Antilles, and has a diverse fauna and flora unique in this group. Regular ornithological surveys were made by Eef Jansen in the 1970s, but little reliable information has been accumulated since then. Being very accessible to nearby hotels, the pond is particularly suitable for nature tourism. STINAPA-Aruba has emphasised the importance of the Sanctuary for tourism, and a proposal has been made to designate the wetland as a Ramsar Site. The Government has been requested to provide funds for an ecological study of the Sanctuary prior to making decisions about future projects using the treated sewage, but there has been no progress to date.
References: Voous (1983).
Source: Vera Rooze.
Criteria for inclusion: 2b.

Reef islands of Aruba (2)

Location: 12°27'N, 69°58'W; 1 km off the southwest coast of Aruba.
Area: c.300 ha.
Altitude: 1-2m.
Province and type: 8.17.4; 03, 05 & 08.
Site description: A chain of nine long thin sandy islands about 1 km off the southwest shore of Aruba Island. There are some mangroves on the islands north of Spanish Lagoon.
Principal vegetation: *Batis maritima, Sesuvium portulacastrum* and *Suriana maritima.*
Land tenure: Owned by the Island Government of Aruba.

Protection: No legal protection, but the islands are patrolled by guards from the nearby oil refinery.
Land use: Public recreation, particularly sailing, and collection of birds' eggs for human consumption.
Waterfowl: The islands near the Lago Refinery are an important breeding area for several species of terns including *Sterna sandvicensis eurygnatha* (1,000-2,500 pairs), *Sterna dougallii* (50 pairs), *Sterna hirundo* (50-70 pairs), and *Sterna albifrons* (10 pairs). The mangrove islands are an important roosting site for *Fregata magnificens* and breeding site for *Pelecanus occidentalis* (20 pairs in 1980).
Other fauna: No information.
Threats: The intensive collection of terns' eggs on the islands near the Lago Refinery has resulted in a decline in the breeding populations. The possibility of oil pollution is considered as only a minor threat, and the refinery is to be closed down in March 1985.
Research and conservation: The islands have been proposed for designation as a Ramsar Site.
References: Jansen *et al* (1982); Voous (1983).
Source: Vera Rooze.
Criteria for inclusion: 2c & 3a.

Spaans Lagoon (Spanish Lagoon) (3)

Location: 12°29'N, 70°00'W; 10 km east of Oranjestad, on the south coast of Aruba.
Area: 70 ha.
Altitude: 0m.
Province and type: 8.17.4; 01, 06 & 08.
Site description: A narrow coastal inlet 2 km long and 200-500m wide, fringed by tidal mudflats and mangrove swamps.
Principal vegetation: Mangroves.
Land tenure: Owned by the Island Government of Aruba.
Protection: Protected as a Conservation Area under the administration of STINAPA. The lagoon was designated as a Ramsar Site in 1980.
Land use: None.
Waterfowl: An important resting and feeding area for a wide variety of water birds.
Other fauna: An important nursery area for species of fishes and crustaceans.
Threats: None known.
References: Kristensen (1980); IUCN (1984).
Source: See references.
Criteria for inclusion: 2c & 3a.

Lac (4)

Location: 12°06'N, 68°14'W; 10 km southeast of Kralendijk, Bonaire.
Area: 800 ha.
Altitude: 0m.
Province and type: 8.17.4; 01 & 08.
Site description: A shallow sea bay, up to 10m deep, with narrow connection to the sea, and some fringing mangrove swamps.
Principal vegetation: Mangrove swamps with *Avicennia germinans* and *Rhizophora mangle*; *Sesuvium portulacastrum* and beds of *Thalassia testudinum*.
Land tenure: Owned by the Island Government of Bonaire.
Protection: Within the Bonaire Underwater Park (6,000 ha) established in 1979. 700 ha of the wetland were designated as a Ramsar Site in 1980.
Land use: Conch fishing, and public recreation.
Waterfowl: The mangroves are an important breeding site for *Butorides virescens curacensis, Egretta caerulea, E. tricolor* and *E. thula*; and *Pelecanus occidentalis* has attempted to nest. A variety of Nearctic shorebirds occur on passage and in winter.

Other fauna: There was a large population of the Queen Conch *Strombus gigas*, but this was heavily overfished, and efforts are now underway to repopulate the area. The Giant Sea-star *Oreaster reticulatus* also occurs.
Threats: Overfishing of the conch population. The development of a tourist village nearby has resulted in the destruction of some mangroves.
References: Kristensen (1980); IUCN (1982 & 1984).
Source: Bart A. de Boer.
Criteria for inclusion: 3a.

Goto-meer (5)

Location: 12°14'N, 68°22'W; 15 km northeast of Kralendijk, Bonaire.
Area: 400 ha.
Altitude: 0m.
Province and type: 8.17.4; 07.
Site description: A permanent shallow saline lagoon separated from the sea by a bar of coral rubble, and with surrounding salt flats. The salinity varies from 40-80 p.p.t.; and the water level is maintained by seepage of sea-water through the coral bar.
Principal vegetation: Salt flat vegetation with *Batis maritima* and *Suriana maritima*. In a region of dry tropical woodland with *Acacia tortuosa*, *Prosopis juliflora*, *Cereus repondus* and *Lemaireocereus griseus*.
Land tenure: Owned by STINAPA (Netherlands Antilles National Park Foundation).
Protection: Within the Washington-Slagbaai National Park (5,900 ha), established in 1969 and enlarged in 1977. 150 ha of the wetland were designated as a Ramsar Site in 1980.
Land use: Tourism within the National Park.
Waterfowl: An important feeding area for *Phoenicopterus ruber*, with 100-500 birds regularly present. Several species of Ardeidae including *Nyctanassa violacea*, *Butorides virescens curacensis* and *Egretta tricolor* have nested. Other breeding species include *Anas bahamensis*, *Haematopus palliatus*, *Charadrius alexandrinus*, *C. wilsonius*, *Himantopus himantopus*, *Larus atricilla* and *Sterna albifrons*. The lagoon is very important during the migration seasons for Nearctic shorebirds; common species include *Pluvialis squatarola*, *Charadrius semipalmatus*, *Numenius phaeopus*, *Arenaria interpres*, *Limnodromus griseus*, *Calidris canutus*, *C. alba*, *C. pusilla*, *C. mauri*, *C. minutilla*, *C. melanotos* and *Micropalama himantopus*. Up to 200 *Anas discors* have occurred in winter.
Other fauna: The brine shrimp *Artemia salina* and the brine fly *Ephydra* sp are abundant and constitute a valuable food source for birds.
Threats: There is a potential threat of oil pollution from a nearby oil terminal, and plans exist for the construction of an oil refinery nearby.
Research and conservation: The avifauna of the area has been well documented.
References: de Boer (1979a); Stinapa (1979); Kristensen (1980); Hof & Kristensen (1982); IUCN (1982 & 1984); Jansen *et al* (1982).
Source: Bart A. de Boer.
Criteria for inclusion: 1b & 3a.

Slagbaai (6)

Location: 12°16'N, 68°25'W; 20 km northeast of Kralendijk, Bonaire.
Area: 250 ha.
Altitude: 0m.
Province and type: 8.17.4; 07.
Site description: A permanent shallow saline lagoon, up to 2m deep, separated from the sea by a bar of coral rubble, and with surrounding salt flats. The lagoon is hyperhaline for most of the year (salinity up to 80 p.p.t.), but becomes brackish after heavy rains. Evaporation is partly compensated by a constant seepage of sea-water through the coral bar.

Principal vegetation: Salt flats with *Batis maritima* and *Suriana maritma.* In a region of dry tropical woodland with *Acacia tortuosa, Prosopis juliflora, Cereus repondus* and *Lemaireocereus griseus.*
Land tenure: Owned by STINAPA (Netherlands Antilles National Park Foundation).
Protection: Within the Washington-Slagbaai National Park (5,900 ha), established in 1969 and enlarged in 1977. 90 ha of the lagoon were designated as a Ramsar Site in 1980.
Land use: Tourism within the National Park.
Waterfowl: An important feeding area for up to 300 *Phoenicopterus ruber*, and resting areafor up to 50 *Phalacrocorax olivaceus.* Important for a variety of Nearctic shorebirds during the migration seasons.
Other fauna: Brine shrimps *Artemia salina* and brine flies *Ephydra* sp are abundant.
Threats: None.
References: Stinapa (1979); Kristensen (1980); Hof & Kristensen (1982); IUCN (1982 & 1984); Jansen *et al* (1982).
Source: Bart A. de Boer.
Criteria for inclusion: 1b & 3a.

AISCO Complex (7)

Location: 12°02'N, 68°15'W; 10 km south of Kralendijk, at the south end of Bonaire.
Area: 2,000 ha.
Altitude: 0m.
Province and type: 8.17.4; 07.
Site description: A complex of shallow saline lagoons (salt condensers); formerly a natural hyperhaline lagoon (Pekelmeer) separated from the sea by a ridge of recrystallized coral debris (beachrock), but converted into a series of impoundments for the commercial exploitation of salt, and now connected to the sea by a channel at the eastern end. The maximum depth of the lagoons is 5m, and the salinity ranges from 40-200 p.p.t.
Principal vegetation: Only some sparse algal growth.
Land tenure: Owned by the Antillean International Salt Company (AISCO).
Protection: 55 ha within the complex were made into a Flamingo Sanctuary in 1969; the remainder of the area is unprotected. 400 ha, including the Sanctuary, were designated as a Ramsar Site in 1980.
Land use: Exploitation of salt. No visitors are allowed into the Flamingo Sanctuary during the breeding season.
Waterfowl: One of the most important breeding sites for the Caribbean Flamingo *Phoenicopterus ruber ruber* and the only known regular breeding site of the south Caribbean population. On average, about 1,000 pairs breed each year, but as many as 3,000 pairs have nested at one time. Other breeding species include *Charadrius alexandrinus, Himantopus himantopus* and *Sterna* spp. The lagoons are also important as feeding areas for Ardeidae and migratory shorebirds.
Other fauna: No information.
Threats: The settling of gypsum on the bottom of the salt condensers has made it impossible for the flamingos to reach the brine fly larvae which constituted their principal diet. The birds have switched to feeding on several species of snail, but the sudden changes in salinity threaten the snail populations. Disturbance from visitors and aircraft overflying the lagoons have caused problems.
Research and conservation: A considerable amount of research has been conducted on the flamingo population, and attempts have been made to manage the sanctuary for the birds. However, as the feeding conditions in the salt complex have changed, the feeding sites along the Venezuelan coast have become relatively more important to the flamingos, particularly during the breeding season.
References: Rooth (1965, 1975, 1976 & 1982); de Boer (1979a, 1979b & in prep); Kristensen (1980); IUCN (1982 & 1984).
Source: Bart A. de Boer.
Criteria for inclusion: 1c & 2c.

Great Salt Pond (8)

Location: 18°02'N, 63°03'W; north of Philipsburg, Sint Maarten.
Area: 225 ha.
Altitude: 0m.
Province and type: 8.41.13; 07.
Site description: A permanent saline lagoon, up to 10m deep, with salinities ranging from 30-100 p.p.t.; surrounded by shrubland.
Principal vegetation: No information.
Land tenure: Owned by the Island Government of Sint Maarten.
Protection: None.
Land use: Dumping of rubbish.
Waterfowl: A feeding area for Ardeidae (*Nyctanassa violacea, Butorides virescens* and *Egretta thula*) and migratory shorebirds.
Other fauna: No information.
Threats: Illegal infilling with rubbish.
Source: J. Vliegen.
Criteria for inclusion: 3a.

Freshpond (9)

Location: 18°02'N, 63°03'W; immediately to the west of Great Salt Pond, north of Philipsburg, Sint Maarten.
Area: 2 ha.
Altitude: 0m.
Province and type: 8.41.13; 13.
Site description: A permanent freshwater pond, up to 3m deep, with some marsh vegetation.
Principal vegetation: No information.
Land tenure: Owned by the Island Government of Sint Maarten.
Protection: None.
Land use: Dumping of rubbish.
Waterfowl: Little information is available; *Gallinula chloropus* breeds and a variety of Ardeidae and shorebirds occur.
Other fauna: No information.
Threats: Illegal infilling with rubbish.
Research and conservation: One of the few permanent freshwater wetlands in the Netherlands Antilles.
Source: J. Vliegen.
Criteria for inclusion: 2b.

Little Bay Pond (10)

Location: 18°01'N, 63°04'W; 1.5 km east of Philipsburg, Sint Maarten.
Area: 2 ha.
Altitude: 0m.
Province and type: 8.41.13; 13.
Site description: A permanent freshwater pond, up to 3m deep, with some marsh vegetation.
Principal vegetation: No information.
Land tenure: Owned by the Island Government of Sint Maarten.
Protection: None.
Land use: In 1981, the area was prepared as a building site, but construction was halted following the bankruptcy of the company involved. The vegetation was totally destroyed, but it is now recovering.
Waterfowl: Little information is available; *Gallinula chloropus* breeds, and a variety of Ardeidae and migratory shorebirds occur.
Other fauna: No information.

Threats: The area may once again be threatened by development.
Research and conservation: One of the few permanent freshwater wetlands in the Netherlands Antilles.
Source: J. Vliegen.
Criteria for inclusion: 2b.

Simpson Bay Lagoon (11)

Location: 18°03'N, 63°07'W; in the western part of Sint Maarten / Saint Martin.
Area: 1,250 ha.
Altitude: 0m.
Province and type: 8.41.13; 07.
Site description: A large permanent saline lagoon, up to 6m deep, with a relatively stable water level and a salinity of 33 p.p.t. About half of the lagoon lies in the French part of the island (see French Antilles site 10).
Principal vegetation: Formerly mangrove swamps, but these have been destroyed.
Land tenure: Owned by the Island Government of Sint Maarten.
Protection: Designated as a Protected Wetland, but no protective measures have been implemented.
Land use: Public recreation, particularly water sports.
Waterfowl: An important feeding area for a variety of Ardeidae and migratory shorebirds.
Other fauna: No information.
Threats: Excessive disturbance from water sports, and destruction of the shoreline vegetation. The mangroves have already been totally destroyed.
Research and conservation: Much the largest wetland on Sint Maarten and in the northern group of the Netherlands Antilles, and still potentially important for wildlife, but under considerable pressure from tourist development and recreation. The status of Protected Wetland has so far had little effect.
Source: J. Vliegen.
Criteria for inclusion: 3a.

PUERTO RICO

INTRODUCTION

by Manuel del Llano, Jose A. Colon and Jose Luis Chabert

Puerto Rico is situated in the Caribbean Sea, to the east of Hispaniola and to the west of the Virgin Islands, between 17°55'-18°31'N and 65°39'-67°15'W. It consists of the island of Puerto Rico, which is the easternmost and smallest of the Greater Antilles, and the two small islands of Vieques and Culebra together with various uninhabited islets. Officially known as the Associated Free State of Puerto Rico, the country is divided into 78 municipalities. It had a population of 3,261,000 in 1982 and a population density of 370 inhabitants per square kilometre. The island of Puerto Rico is almost rectangular in shape, measuring some 175.5 km from east to west and 64.4 km from north to south. Its total surface area is 8,897 km^2. The topography is rugged, with many high peaks. The three main mountain ranges are the Sierra de Luquillo in the northeast, the Sierra de Cayey in the southeast, and the Cordillera Central extending through the interior of the island from northeast to southwest. The highest peak is Cerro Punta (1,337m) in the Cordillera Central.

The climate has been described as marine subtropical, and is influenced by almost constant sea breezes. There are two rainy seasons, one between July and November (the hurricane season) and the other during the month of May. There are also two dry seasons, one between December and April (if there are no significant cold fronts) and the other during June. The average annual rainfall varies from over 5,000 mm in the Sierra de Luquillo to less than 1,000 mm on the south coast. The offshore islands of Mona, Vieques and Culebra receive an average annual rainfall of 1,000-1,300 mm. Tropical storms and hurricanes develop with easterly air streams and are accompanied by torrential rain and high seas. Occasionally, cold fronts during the winter months bring torrential rain for several days and cause extensive flooding. The average temperature varies very little between the hottest and coldest months; 28.1°C in September and 25.5°C in February.

Of the country's 1,200 water courses, barely fifty can be classified as rivers, and all those in the eastern and central watersheds are intermittent. Subterranean water courses are abundant and there are important thermal springs with sulphurous waters at the Baños de Coamo.

Monroe (1980), referring to the geological age of the island, considers the oldest rocks in the highlands of Puerto Rico as belonging to the Lower Cretaceous, and divides the island into three main geographical regions:

a) The mountainous region, with rocks of predominantly volcanic origin; belonging to the Lower Cretaceous and Mid Eocene, and surrounded by a karst region.
b) The karst region, composed of sedimentary and metamorphic rocks; characterized by its irregular topography with limestone formations (mogotes) and undulating plains.
c) The fringe of relatively flat coastal plains, composed of boulders, gravel, sand, clay and mud overlying the bedrock.

The native vegetation of Puerto Rico, as recorded in 16th Century accounts, consisted of dense forests in the mountains and on the plains, savanna on the river banks, marsh vegetation around lakes and ponds, mangrove swamps, and saline lagoons almost devoid of vegetation on the south coast.

Institutional Base for Wetland Conservation and Research

The Departamento de Recursos Naturales de Puerto Rico is the governmental organization concerned with nature conservation, and has legal and state jurisdiction over wildlife and its habitats. Various state and federal laws and regulations adminstered by this Department are relevant to wetlands and their fauna. This institutional base also provides for research and management programmes.

Progress in Wetland Conservation

Puerto Rico has twenty-eight Nature Reserves (Reservas Naturales). The principal laws relating to nature protection include the following:

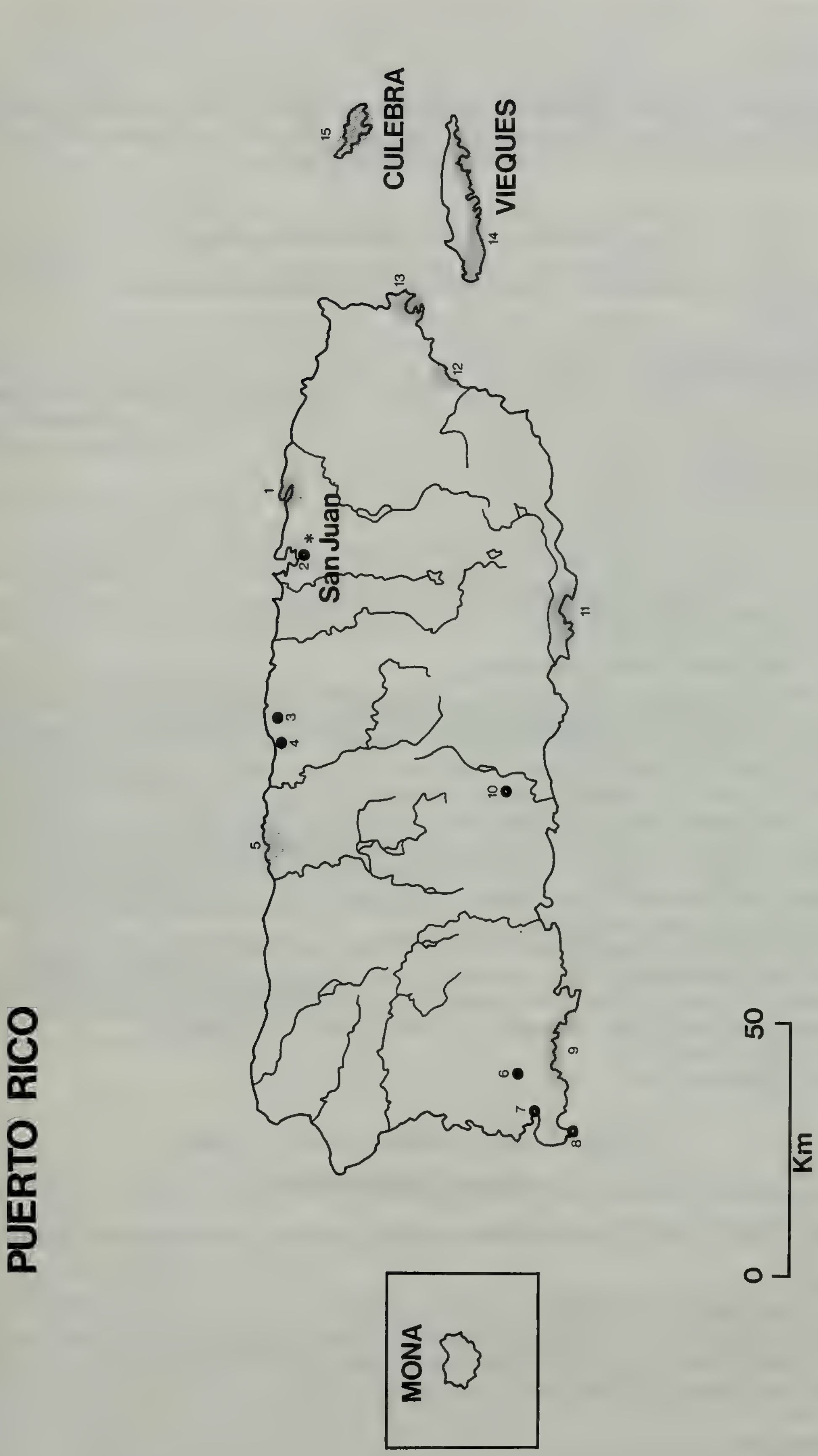
a) The Ley de Vida Silvestre, which provides a mechanism for protecting habitats, including wetlands of special importance for waterfowl.
b) The Ley de Bosques, which provides a mechanism for administering and protecting the country's forests, including mangroves and other coastal marshes.
c) The Ley de Vigilantes de Recursos Naturales, which provides the basis for a wardening system.

The Federal Government of the United States of America applies laws and regulations in Puerto Rico which favour the protection of wetlands. These include:

a) The Clear Water Act, one of the most effective mechanisms for preventing the harmful modification of wetlands.
b) The Endangered Species Act, which provides protection to certain species and habitats.
c) The National Environmental Policy Act, which requires an evaluation of the environmental impact of important development projects, and which has served as a model for a state law of the same name.enumerate

Major Threats to Wetlands

In becoming a densely populated island with intensive industrial development, Puerto Rico has had to pay a high price in terms of deterioration in environmental quality. The causes of this environmental deterioration are numerous and include: excessive drainage of wetlands; diversion of water courses; deforestation of watersheds; erosion and sedimentation associated with inadequate measures for soil conservation; filling in of wetlands for construction; excessive use of fertilizers, insecticides and herbicides; establishment of sanitary land-fills; disposal of domestic sewage; damming of rivers; and mining and quarrying activities.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WETLANDS

Site descriptions based on information received from Jose A. Colon and Manuel del Llano of the Department of Natural Resources, and the literature, principally Baker (1979), Chabert *et al* (1984), Moreno *et al* (1983) and Raffaele (1979a & 1983).

Torrecilla - Piñones and Torrecilla Alta (1)

Location: 18°26'N, 65°58'W; 10 km west of San Juan, Carolina Municipality.
Area: c.2,000 ha.
Altitude: 0-1m.
Province and type: 8.40.13; 05, 07, 08 & 12.
Site description: A complex of estuarine lagoons, including brackish open-water ponds and lagoons, mangrove swamps, *Pterocarpus* forest and herbaceous swamps, surrounded by savanna and separated from the sea by a coastal sand barrier. There is a shallow freshwater lake with abundant emergent vegetation at Torrecilla Alta in the southeast.
Principal vegetation: Mangrove swamps; swamp forest with *Pterocarpus officinalis*; herbaceous marshes with *Typha domingensis*, *Cladium jamaicensis*, *Acrostichum* spp and *Cyperus giganteus*; and aquatic beds of *Eichhornia crassipes*, *Pistia stratiotes*, *Nymphaea* spp and *Lemna perpusilla*. Evergreen littoral woodland and coconut groves on the adjacent sand barrier.
Land tenure: Mainly privately owned; 625 ha are state owned.
Protection: Parts of the wetland are protected in the Piñones State Forest and in a small reserve with a Biological Research Station.
Land use: Recreation, hunting and fishing.
Waterfowl: An important feeding and roosting area for resident, passage and wintering waterfowl. The roost on Carmelita Island in Piñones Lagoon includes up to 125 *Pelecanus occidentalis*, 300 *Egretta thula*, thousands of *Bubulcus ibis*, and up to 100 *E. caerulea*, *E. tricolor*, *E. alba* and *Ardea herodias*. *Bubulcus ibis* also breeds, and *Dendrocygna arborea* is reported to occur at Torrecilla Alta. Common passage migrants and winter visitors include *Anas discors*, *Pluvialis squatarola*, *Charadrius semipalmatus*, *Tringa melanoleuca*, *T. flavipes*, *Actitis macularia*, *Calidris pusilla*, *Himantopus himantopus* and several Laridae.
Other fauna: *Pandion haliaetus*, *Ceryle alcyon* and the Yellow-shouldered Blackbird *Agelaius xanthomus* occur in winter. The mangroves support a very high density of wintering *Seiurus noveboracensis* and other Nearctic Parulidae.
Threats: There is a considerable amount of disturbance from nearby human habitation.
Research and conservation: A management plan has been prepared for the Piñones State Forest, and Raffaele has made some recommendations concerning management of the wetlands.
References: Raffaele (1979a); Moreno *et al* (1983); Chabert *et al* (1984).
Source: Jose A. Colon.
Criteria for inclusion: 3a.

Constitution Bridge Mudflats (2)

Location: 18°26'N, 66°05'W; at Constitution Bridge in San Juan, San Juan Municipality.
Area: 20 ha.
Altitude: 0m.
Province and type: 8.40.13; 06 & 08.
Site description: An area of intertidal mudflats with heavy algal growth. The southern part has been raised by siltation and is being colonized by mangroves.
Principal vegetation: Mangroves and marine algae.
Land tenure: State owned.
Protection: None.
Land use: No information.
Waterfowl: Formerly the richest area for migratory shorebirds in Puerto Rico, with concentrations of up to 5,000 birds, but numbers have declined somewhat in recent years.

Common species include *Pluvialis squatarola, Charadrius semipalmatus, C. wilsonius, C. vociferus, Numenius phaeopus, Tringa melanoleuca, T. flavipes, Catoptrophorus semipalmatus, Actitis macularia, Arenaria interpres, Limnodromus griseus, Calidris pusilla, C. minutilla, Micropalama himantopus* and *Himantopus himantopus.* Up to 250 *Pelecanus occidentalis* feed and roost in the area; there is a large roost of *Bubulcus ibis* (up to 1,000), *Egretta tricolor* and *E. thula*; *E. rufescens* and several other Ardeidae are resident in small numbers; and a wide variety of Laridae occur on passage and in winter.
Other fauna: No information.
Threats: A part of the mudflat has already been destroyed by silt laden run-off, and a significant portion of the mangroves has been destroyed for construction of sports facilities. Further habitat loss is likely from general urbanization and industrialization in the area.
Research and conservation: The avifauna has been well studied and documented. Raffaele and Moreno *et al* have made recommendations concerning the management of the area. The mudflats could still be restored to their former importance by removing excess silt. Because of its proximity to San Juan, the area is an ideal location for an environmental education facility.
References: Baker (1979); Raffaele (1979a); Moreno *et al* (1983).
Source: See references.
Criteria for inclusion: 3a.

Cibuco Swamp (3)

Location: 18°28'N, 66°23'W; 30 km west of San Juan, Vega Baja Municipality.
Area: c.450 ha.
Altitude: 0-1m.
Province and type: 8.40.13; 08 & 13.
Site description: An estuarine lagoon with mangrove swamps and herbaceous marshes.
Principal vegetation: Mangrove swamps, and herbaceous marshes with *Typha domingensis* and *Acrostichum* spp.
Land tenure: No information.
Protection: None.
Land use: Recreation, hunting and fishing.
Waterfowl: Poorly known; *Ardea herodias, Dendrocygna arborea* and *Fulica caribaea* are resident, and probably breed.
Other fauna: *Pandion haliaetus* occurs in winter.
Threats: The wetland is threatened by drainage for agricultural and industrial use, and increased recreational activities.
References: Baker (1979); Raffaele (1979a).
Source: See references.
Criteria for inclusion: 2a & 3a.

Tortuguero Lagoon and Cabo Caribe Swamp (4)

Location: 18°27'N, 66°27'W; 40 km west of San Juan, Manati and Vega Baja Municipalities.
Area: c.1,000 ha.
Altitude: 0-2m.
Province and type: 8.40.13; 05, 07 & 13.
Site description: Tortuguero Lagoon is a shallow estuarine lagoon with relatively stable water level and with beds of aquatic vegetation and herbaceous swamps. It lies behind a coastal sand barrier and is connected to the sea at the north end by a man-made channel through which sea water enters during high tides. The lagoon is the only spring-fed lagoon in Puerto Rico. Cabo Caribe Swamp is a large freshwater herbaceous swamp to the east of Tortuguero Lagoon; it is connected to Tortuguero Lagoon by a man-made channel.
Principal vegetation: Herbaceous marshes with *Typha domingensis, Eleocharis mutata, Cladium jamaicensis, Phragmites australis* and *Sagittaria lancifolia*; aquatic beds of *Eichhornia crassipes, Nymphaea spp, Lemna perpusilla* and *Utricularia spp*; and submergent beds of *Ceratophyllum demersum.* Savanna, evergreen forest with some *Pterocarpus officinalis*, and

evergreen littoral vegetation dominated by *Coccoloba uvifera* in surrounding areas.
Land tenure: Partly state owned, and partly owned by a private company.
Protection: Designated as a Natural Reserve by the State Planning Board.
Land use: Recreation, hunting and fishing.
Waterfowl: *Podilymbus podiceps, Podiceps dominicus, Ixobrychus exilis, Nycticorax nycticorax, Butorides virescens, Oxyura jamaicensis, Porphyrula martinica* and *Fulica caribaea* are known to breed, and *Dendrocygna bicolor, D. arborea* and *Porzana flaviventer* probably breed. Winter visitors include *Botaurus lentiginosus, Anas acuta, A. discors, A. clypeata, Porzana carolina* and *Laterallus jamaicensis.*
Other fauna: *Pandion haliaetus* occurs in winter. The lagoon has a rich fish fauna and large population of shrimps; and the nearby beaches are used by nesting sea turtles, particularly *Eretmochelys imbricata.*
Threats: There has been some filling of the wetlands for house construction. Several pharmaceutical factories have been constructed in the vicinity, and water pollution is a problem.
Research and conservation: Funds have been obtained to acquire the lagoon and adjacent lands for the Natural Reserve.
References: Baker (1979); Raffaele (1979a).
Source: Jose A. Colon.
Criteria for inclusion: 2a, 2b & 3a.

Tiburones Swamp (5)

Location: 18°28'N, 66°41'W; 60 km west of San Juan, Arecibo Municipality.
Area: 400 ha.
Altitude: 0m.
Province and type: 8.40.13; 07, 08 & 13.
Site description: A shallow brackish coastal lagoon with extensive fresh to brackish herbaceous marshes and some remnants of mangrove swamps.
Principal vegetation: Mangroves; herbaceous marshes with *Typha domingensis, Cladium jamaicensis, Arundo donax, Paspalidium geminatum, Paspalum distichum, Eleocharis mutata, Panicum hirsutum* and *Acrostichum spp*; aquatic beds of *Nymphaea ampla*; and submergent beds of *Ceratophyllum demersum.* Scrub-thicket associations in surrounding areas.
Land tenure: State owned (Commonwealth Land Authority).
Protection: None.
Land use: Livestock grazing and cultivation of sugar cane in surrounding areas; the cultivation of rice is being developed.
Waterfowl: Resident species known or thought to breed include *Podiceps dominicus, Dendrocygna bicolor, D. arborea, Oxyura jamaicensis, Porzana flaviventer* and *Fulica caribaea.* Passage migrants and winter visitors include *Botaurus lentiginosus, Plegadis falcinellus, Anas acuta, A. discors, A. clypeata* and *Porzana carolina.*
Other fauna: *Asio flammeus* is a resident breeder and *Pandion haliaetus* occurs in winter.
Threats: Much of the wetland has already been drained for pastureland and the cultivation of sugar cane; the expansion of rice cultivation is now the principal threat.
Research and conservation: The wetland still has outstanding potential for waterfowl and other freshwater fauna. Raffaele has made some recommendations concerning restoration and management of the swamp.
References: Baker (1979); Raffaele (1979a); Chabert *et al* (1984).
Source: Jose A. Colon.
Criteria for inclusion: 2a & 3a.

Cartagena Lagoon (6)

Location: 18°01'N, 67°06'W; 22 km SSE of Mayaguez, Lajas Municipality.
Area: 325 ha.
Altitude: 10m.
Province and type: 8.40.13; 12.

Site description: A permanent shallow freshwater lake with extensive marshes and marshy grassland. Almost the whole of the lake is overgrown with floating and emergent vegetation, and there is very little open water.
Principal vegetation: Herbaceous swamps with *Typha domingensis, Schoenoplectus validus, Polygonum* sp and *Eleocharis intersticta*, and aquatic beds of *Pistia stratiotes, Lemna perpusilla* and *Eichhornia crassipes.*
Land tenure: Privately owned, but with definite plans for acquistion by the government in the near future.
Protection: None at present.
Land use: A major duck hunting area. Detailed statistics were taken in the 1950s, when about 3,000 birds were shot per year. Cultivation of sugar cane and cattle ranching in surrounding areas.
Waterfowl: A very important area for breeding, passage and wintering waterfowl of a wide variety of species. Up to 30,000 Anatidae have been observed in the past, but numbers have been much lower in recent years. Species known or thought to breed include *Podiceps dominicus, Ixobrychus exilis, Nycticorax nycticorax, Butorides virescens, Plegadis falcinellus, Dendrocygna bicolor, D. arborea, Oxyura jamaicensis, O. dominica, Porzana flaviventer, Porphyrula martinica* and *Fulica caribaea.* For several of these species, the lake is now the most important area in Puerto Rico. Regular passage migrants and winter visitors include *Botaurus lentiginosus, Anas crecca, A. acuta, A. discors, A. clypeata, Aythya collaris, Porzana carolina* and many shorebirds.
Other fauna: *Pandion haliaetus, Falco peregrinus, F. columbarius* and *Ceryle alcyon* occur on passage and in winter, and the Yellow-shouldered Blackbird *Agelaius xanthomus* commonly forages in the area.
Threats: The main threat is further drainage for agricultural land. The wetland has been gradually reduced in extent by a number of drainage schemes during the past fifty years, and this continues. The amount of open water has been much reduced by accelerated eutrophication resulting from the excessive use of fertilizers on adjacent land.
Research and conservation: Cartagena Lagoon is undoubtedly the finest and most important freshwater swamp remaining in Puerto Rico. Its fauna and flora have been well studied and documented, and a number of management proposals have been made. The site is to be acquired by the government in the near future and protected and managed as a Wildlife Refuge. A substantial amount of habitat management will be required to reduce the rate of eutrophication and control the spread of aquatic plants.
References: McCandless (1956); Baker (1979); Raffaele (1979a & 1983); Moreno *et al* (1983); Chabert *et al* (1984).
Source: Jose A. Colon.
Criteria for inclusion: 123.

Boqueron Refuge (7)

Location: 18°01'N, 67°10'W; 20 km south of Mayaguez, Cabo Rojo Municipality.
Area: c.200 ha.
Altitude: 0m.
Province and type: 8.40.13; 07 & 08.
Site description: An estuarine bay with mangrove swamps and herbaceous marshes, impounded in the late 1960s to create waterfowl breeding habitat and to improve opportunities for duck hunting.
Principal vegetation: Mangroves; herbaceous marshes with *Typha domingensis* and *Paspalum distichum*; and submergent beds of *Ruppia maritima, Thalassia testudinum, Syringodium filiformis* and *Ceratophyllum demersum.*
Land tenure: State owned.
Protection: Protected in the Boqueron Wildlife Refuge.
Land use: Managed by the Department of Natural Resources as a waterfowl hunting area.
Waterfowl: An important breeding area for a variety of waterfowl including *Nycticorax nycticorax* (up to 150); and an important wintering area for Anatidae (mainly *Anas discors* and *Oxyura jamaicensis*), *Fulica americana* and some shorebirds.
Other fauna: No information.

Threats: None, other than considerable disturbance from hunting activities.
Research and conservation: A management plan was prepared by the Division of Fish and Wildlife Planning in 1976.
References: Raffaele (1979a); Chabert *et al* (1984).
Source: Jose A. Colon.
Criteria for inclusion: 3a.

Cabo Rojo Salt Flats (8)

Location: 17°57'N, 67°11'W; 30 km south of Mayaguez, at the extreme southwest tip of Puerto Rico, Cabo Rojo Municipality.
Area: c.600 ha.
Altitude: 0m.
Province and type: 8.40.13; 04, 05, 06, 07 & 08.
Site description: A complex of permanent and seasonal saline lagoons, salt flats, tidal mudflats and mangrove swamps with adjacent sandy beaches, rocky shores and sea cliffs.
Principal vegetation: Mangroves, and sparse herbaceous vegetation with *Sporobolus virginicus, Fimbristylis cymosa, Batis maritima* and *Sesuvium portulacastrum.*
Land tenure: Partly state owned (Boqueron State Forest) and partly privately owned.
Protection: Within the Boqueron State Forest.
Land use: Production of salt and recreation. There is a lighthouse on the headland.
Waterfowl: The only breeding site in Puerto Rico for *Charadrius alexandrinus*, and a breeding area for *Rallus longirostris* and *Sterna albifrons.* Very important for passage and wintering shorebirds, with concentrations of up to 10,000, and an important feeding area for *Pelecanus occidentalis*, Ardeidae and Laridae. Common species include *Nyctanassa violacea, Bubulcus ibis, Egretta caerulea, E. tricolor, E. thula, E. alba, Ardea herodias, Pluvialis squatarola, Charadrius semipalmatus, C. wilsonius, Tringa melanoleuca, T. flavipes* (abundant), *Actitis macularia, Arenaria interpres, Calidris alba, C. pusilla* (abundant), *C. mauri, C. minutilla, Micropalama himantopus, Himantopus himantopus, Larus atricilla* and *Sterna hirundo.*
Other fauna: *Pandion haliaetus, Falco peregrinus, F. columbarius* and *Ceryle alcyon* occur in winter, and *Agelaius xanthomus* is a common visitor from nearby breeding areas.
Threats: The principal threats are the development of the salt industry and the recreational use of the flats by off-road vehicles.
References: Raffaele (1979a & 1983); Moreno *et al* (1983).
Source: Jose A. Colon.
Criteria for inclusion: 2a & 3a.

La Parguera Wetland (9)

Location: 17°58'N, 67°04'W; 28 km SSE of Mayaguez, Lajas Municipality.
Area: 400 ha.
Altitude: 0-1m.
Province and type: 8.40.13; 03, 06, 07 & 08.
Site description: A coastal strip of mangrove swamps, intertidal mudflats, natural salt flats, old salt pans (salinas) and shallow saline lagoons, with numerous mangrove covered cays, coral reefs and sea grass beds offshore.
Principal vegetation: Mangrove swamps with *Rhizophora mangle* (dominant) and *Avicennia germinans*; salt flats and marshes with *Sporobolus virginicus, Fimbristylis cymosa, Batis maritima, Sesuvium portulacastrum* and *Philoxerus vermicularis*; littoral scrub with *Coccoloba uvifera, Conocarpus erectus, Colubrina arborescens* and *Thespesia populnea*; extensive beds of *Thalassia testudinum* offshore.
Land tenure: Largely owned by the state (Boqueron State Forest) and the Conservation Trust.
Protection: Within the Boqueron State Forest.
Land use: Fishing and tourism; the fishing village of La Parguera lies at the west end of the wetland and there is grazing of domestic livestock inland. Some areas were formerly used for solar salt production.

Waterfowl: One of only two breeding sites for *Pelecanus occidentalis* in Puerto Rico with 25 pairs in 1978. Other resident species include *Nycticorax nycticorax, Nyctanassa violacea, Bubulcus ibis, Egretta caerulea, E. tricolor, E. thula, E. alba, Ardea herodias, Rallus longirostris, Charadrius wilsonius, C. vociferus, Himantopus himantopus, Sterna hirundo* and *S. albifrons. Anas bahamensis* occurs in small numbers and may breed. The wetland is a very important feeding area for Ardeidae and migratory shorebirds, with almost the same species as the Cabo Rojo Salt Flats (site 8).

Other fauna: The mangrove swamps provide breeding and roosting habitat for the largest remaining population of the endangered Yellow-shouldered Blackbird *Agelaius xanthomus. Pandion haliaetus* and a number of North American Parulidae are winter visitors. The manatee *Trichechus manatus* and the sea turtle *Eretmochelys imbricata* occur offshore, but both are rare. Crustaceans include *Uca* spp, *Goniopsis cruentata, Sesarma* spp, *Cardisoma guanhumi, Ucides chordatus* and *Callinectes* spp. High densities of bioluminescent organisms occur in Bahia Fosforescente and Bahia Monsio Jose, and provide an important tourist attraction. A variety of introduced mammals occur including the monkeys *Macaca mulatta* and *Erithrocebus patas*, and the mongoose *Herpestes auropunctatus*.

Threats: The many threats to the area include: encroachment from the village of La Parguera and other nearby communities, and invasion of the littoral zone by private weekend cottages; pollution with domestic sewage from these residential areas; destruction of the mangroves which provide natural protection from storm damage; pollution from a nearby petroleum industry; considerable disturbance from boat traffic; heavy use by off-road vehicles; and increased sedimentation as a result of erosion inland caused by deforestation, overgrazing and burning. The Yellow-shouldered Blackbird is suffering nest parasitism from a recent invader, *Molothrus bonariensis*, and feral populations of monkeys are menacing bird populations, particularly ground-nesting species.

Research and conservation: There is a Marine Sciences Laboratory of the University of Puerto Rico at Magueyes Island, and many studies have been carried out on reef, mangrove and sea grass ecosystems as well as the phenomenon of bioluminescence. The fauna and flora of the region have been well documented, and a considerable amount of research is being carried out on the Yellow-shouldered Blackbirds, for which numerous nest-boxes have been erected. Proposals have been made for the establishment of a National Marine Sanctuary and a Nature Reserve; the latter would incorporate all the mangrove swamps and saline lagoons as well as Bahia Fosforescente and Bahia Monsio Jose. Management plans have been prepared for both of these proposed reserves by the U.S. Department of Commerce and the Department of Natural Resources.

References: Odum *et al* (1959); Seliger & Carpenter (1970); Baker (1979); Raffaele (1979a); Schreiber *et al* (1981); Furniss (1982); Diaz & Cintron *et al* (1983); Moreno *et al* (1983); U.S. Dept. of Commerce (1983).

Source: Jose A. Colon and Manuel del Llano.

Criteria for inclusion: 2a, 2b & 3a.

Serralles Lakes (10)

Location: 18°04'N, 66°33'W; 10 km northeast of Ponce, Juana Diaz Municipality.

Area: A few hundred hectares.

Altitude: Over 100m.

Province and type: 8.40.13; 15.

Site description: A group of small freshwater reservoirs, including Lago Poncena, in the hills northeast of Ponce. The lakes are deep, with narrow shorelines and little emergent vegetation.

Principal vegetation: Herbaceous marshes with *Typha domingensis* and *Brachiaria purpurascens.*

Land tenure: Privately owned.

Protection: No habitat protection, but hunting is prohibited.

Land use: The lakes are used to irrigate sugar cane fields.

Waterfowl: A breeding area for *Oxyura jamaicensis, Gallinula chloropus, Porphyrula martinica* and *Fulica caribaea*, and a wintering area for Anatidae and *Fulica americana.* Other species known to occur include *Ixobrychus exilis, Nycticorax nycticorax, Bubulcus ibis, Butorides virescens, Egretta caerulea, E. tricolor, E. thula, E. alba* and *Ardea herodias.*

Other fauna: No information.

Threats: None known.
Research and conservation: The only inland lake system in Puerto Rico of importance for wildlife.
References: Raffaele (1979a); Chabert *et al* (1984).
Source: Jose A. Colon.
Criteria for inclusion: 3a.

Bahia de Jobos, Punta Pozuelo and Mar Negro (11)

Location: 17°56'N, 66°13'W; 35 km ESE of Ponce, Guayama and Salinas Municipalities.
Area: 1,600 ha.
Altitude: 0m.
Province and type: 8.40.13; 01, 02, 03, 06, 07 & 08.
Site description: An estuarine system around a shallow sea bay, with an extensive network of channels, intertidal mudflats, mangrove swamps (400 ha), salt flats, brackish marshes, some saline lagoons, and a group of mangrove covered cays (Cayos Caribe). There are extensive coral reefs and sea grass beds offshore.
Principal vegetation: Mangrove swamps with *Rhizophora mangle* (dominant), *Avicennia germinans, Laguncularia racemosa* and *Conocarpus erectus*; brackish marshes with *Typha domingensis, Eleocharis mutata, Fimbristylis ferruginea, Colocasia esculenta, Schoenoplectus americanus, Paspalidium geminatum, Paspalum* spp, *Echinochloa colona* and *Cyperus rotunda*; salt flats and saline marshes with *Batis maritima, Sesuvium portulacastrum, Sporobolus virginicus* and *Fimbristylis cymosa*; sea grass beds with *Thalassia testudinum, Cymodocea filiformis* and *Diplanthera wrightii.*
Land tenure: A large part of the mangroves are state owned; other areas are privately owned.
Protection: There is a National Estuarine Sanctuary at Mar Negro; the mangroves at Punta Arenas are protected by a Commonwealth Law; and most of the mangroves at Punta Pozuelo are included in the Aquirre State Forest.
Land use: Hunting and fishing; intensive farming inland.
Waterfowl: An important breeding, passage and wintering area for a wide variety of waterfowl, and one of the best areas in Puerto Rico for migratory shorebirds. There is a large breeding colony of Ardeidae, principally *Bubulcus ibis*, on Cayos Caribe. *Pelecanus occidentalis* is a common non-breeding visitor and *Anas bahamensis* occurs in small numbers. Shorebirds and Laridae include the same species as at Cabo Rojo Salt Flats (site 8).
Other fauna: Fifty-two species of birds have been recorded including the rare *Columba inornata wetmorei, C. leucocephala* and *Agelaius xanthomus.* The bay is one of the most important areas in Puerto Rico for the manatee *Trichechus manatus* and an important feeding area for the sea turtles *Chelonia mydas* and *Eretmochelys imbricata.* The introduced mongoose *Herpestes auropunctatus* is very common. The fish fauna has been well documented; over 260 species have been recorded in the bay and among the cays, including many commercially important species. The rich invertebrate fauna includes large populations of lobsters *Panulirus* sp and the molluscs *Crassostrea rhizophorae, Isognomon alatus* and *Brachiodontes exustus.*
Threats: Threats include destruction of mangroves by land fill; the cutting of mangrove roots for the collection of oysters; the dumping of rubbish at Punta Arenas; increased utilization of aquifers for heavy industry and agriculture; pollution from pesticides and nearby industrial development; increased sedimentation as a result of soil erosion inland; eutrophication of estuarine conditions through excessive use of fertilizers; and illegal hunting. Dredging and discharge of hot water have depleted the sea grass beds in the bay.
Research and conservation: Bahia de Jobos was designated as a Special Planning Area by the Coastal Zone Management Program in 1978, and a proposal has been made for the establishment of a Natural Reserve which would incorporate the existing National Estuarine Sanctuary. The Department of Natural Resources has prepared a management plan for the proposed reserve; the technical supplement to this management plan describes the fauna and flora in some detail and makes a variety of recommendations concerning research and management.

References: Cintron *et al* (1975); Baker (1979); Raffaele (1979a); Villamil & Canals (1981); Diaz & del Llano *et al* (1983); Moreno *et al* (1983); Chabert *et al* (1984).
Source: Manuel del Llano.
Criteria for inclusion: 2a, 2c & 3a.

Humacao Swamp (12)

Location: 18°11'N, 65°46'W; 40 km southwest of San Juan, Naguabo and Humacao Municipalities.
Area: c.3,000 ha.
Altitude: 0-2m.
Province and type: 8.40.13; 02, 07, 08, 12, 16 & 18.
Site description: A complex of fresh to brackish estuarine lagoons, generally under 2m deep, herbaceous swamps and seasonally flooded marshes, including the two Santa Theresa lagoons in the Caño Frontera drainage and the three Mandri lagoons in the drainage of the Mandri and Anton Ruiz rivers; and 360 ha of *Pterocarpus* swamp forest and mangrove swamps along the Anton Ruiz River in the north. Salinities range from 1-15 p.p.t. The wetlands were largely drained in the 1930s for the production of sugar cane, but the old pumping system failed completely in 1979 and the wetlands have since refilled.
Principal vegetation: Mangrove swamps with *Rhizophora mangle* and *Laguncularia racemosa*; swamp forest of *Pterocarpus officinalis* with some Puerto Rican Royal Palm *Roystonea sp*; herbaceous swamps with *Typha domingensis, Hymenachne amplexicaule* and *Panicum aquaticum*; aquatic beds of *Eichhornia crassipes, Nymphaea spp* and *Marsilea polycarpa*; submergent beds of *Thalassia testudinum, Syringodium filiformis* and *Ceratophyllum demersum*; seasonally flooded marshes with species of *Paspalum, Cyperus, Brachiaria* and *Eriochloa.* The *Pterocarpus* forest along the backwaters of the Anton Ruiz River is the largest remaining stand of this species in Puerto Rico. In the subtropical moist forest life zone.
Land tenure: A mixture of state and private ownership.
Protection: No legal habitat protection, but the wetland is managed by the state.
Land use: Hunting and fishing.
Waterfowl: An important breeding area for many waterfowl including *Podilymbus podiceps*, a variety of Ardeidae, *Dendrocygna arborea* (particularly in the *Pterocarpus* forest), *Oxyura jamaicensis, Rallus longirostris, Gallinula chloropus* and *Porphyrula martinica.* *Oxyura dominica* has been recorded and may breed. Up to 450 *Pelecanus occidentalis* have been observed feeding in the lakes; all the Ardeidae occurring in Puerto Rico are abundant; and *Phalacrocorax auritus* and a variety of Anatidae and shorebirds occur on passage and in winter.
Other fauna: *Pandion haliaetus* is a common winter visitor. The area is very rich in birdlife, and over 85 species have been recorded. Mammals include the introduced mongoose *Herpestes auropunctatus*; reptiles include the freshwater turtle *Pseudemys terrapen*, and amphibians include *Eleutherodactylus* sp, *Leptodactylus albilabris, Bufo marinus* and *Rana cabesbiana.* Twenty-six species of freshwater, estuarine and marine fishes have been recorded including a number of commercially important species, and it is likely that the swamp is a nursery area for offshore fisheries. The crab *Callinectes* sp is particularly abundant, and four species of shrimps occur (*Macrobrachium* spp and *Paleomonon pandaliformis*).
Threats: Caño Frontera and the two Santa Theresa lagoons have been subjected to industrial pollution from a nearby factory complex and there is a danger that this pollution will spread northwards through the wetland. Other threats include urban development in the Caño Frontera drainage, expansion of agriculture in surrounding areas, and a considerable amount of disturbance from hunting. There are plans to install flood control measures which may have a pronounced effect on the ecology of the wetland.
Research and conservation: One of Puerto Rico's prime wildlife areas, in urgent need of proper protection. The fauna and flora have been well documented, and several studies have been carried out on pollution in Caño Frontera. The *Pterocarpus* swamp and adjacent riverine mangroves were proposed as a National Monument and Wildlife Refuge by the Puerto Rico Natural History Society in 1980, and the Department of Natural Resources has proposed the establishment of a Wildlife Refuge in the three Mandri lagoons. The Government is now trying to acquire land from the owners to establish a refuge. The Department of Natural

Resources has also investigated the possibility of designing a system of flood control which will protect the residents of Punta Santiago from flooding while conserving the wildlife values of the lagoon ecosystem and preventing pollution in the southern lagoons from spreading into the northern system.
References: Baker (1979); Raffaele (1979a); Puerto Rico Natural History Society (1980); Puerto Rico Department of Natural Resources (1981); Cintron (1983); Chabert *et al* (1984).
Source: Jose A. Colon and Manuel del Llano.
Criteria for inclusion: 2a, 2b & 3a.

Roosevelt Roads Naval Reservation (13)

Location: 18°14'N, 65°37'W; at the eastern tip of Puerto Rico, 50 km ESE of San Juan, Ceiba Municipality.
Area: c.2,400 ha.
Altitude: 0m.
Province and type: 8.40.13; 06, 07 & 08.
Site description: A complex of shallow brackish lagoons, extensive mangrove swamps and intertidal mudflats, with offshore beds of marine grasses.
Principal vegetation: Mangrove swamps.
Land tenure: Owned by the Federal Government of the U.S.A.
Protection: No legal habitat protection, but the area is protected from intrusion by the Naval Authorities.
Land use: A U.S. Naval Base. The wetland habitats are almost undisturbed.
Waterfowl: An important area for *Pelecanus occidentalis*, a variety of Ardeidae, *Dendrocygna arborea, Anas bahamensis* and many passage and wintering shorebirds and Laridae.
Other fauna: There are several breeding colonies of the endangered Yellow-shouldered Blackbird *Agelaius xanthomus* in the mangroves, and the wetland is the most important area in Puerto Rico for the manatee *Trichechus manatus*.
Threats: Expansion of buildings within the grounds of the naval base is the only threat as long as the U.S. Navy remains in control.
References: Baker (1979); Raffaele (1979a); Moreno *et al* (1983); Chabert *et al* (1984).
Source: See references.
Criteria for inclusion: 2a, 2b & 3a.

Wetlands on Vieques Island (14)

Location: 18°07'N, 65°26'W; 23 km east of the Puerto Rican mainland, Vieques Municipality.
Area: Unknown. (Entire island 13,470 ha.)
Altitude: 0-10m.
Province and type: 8.40.13; 03, 04, 05, 06, 07 & 08.
Site description: A number of shallow brackish to saline lagoons, mangrove swamps, intertidal mudflats, channels and mangrove covered cays, mainly along the south shore and at the west end of Vieques Island; also several rocky offshore islets. The principal wetlands are mangrove swamps and the Kiani lagoons at the west end of the island; saline ponds and mangrove swamps at Ensenada Sombe Swamp, Mosquito Bay and Ferro Bay; a large saline lagoon at Tapon Bay; Chiva Swamp; Yanuel Lagoon; and mangrove swamps at Ensenada Honda.
Principal vegetation: Mangrove swamps. Dry subtropical forest inland.
Land tenure: Three-quarters of the island is owned by the Federal Government of the U.S.A., and most of the rest is state owned.
Protection: No legal habitat protection, but large parts are protected from intrusion by the Naval Authorities.
Land use: Part of the island is a U.S. Naval Base. There is some livestock grazing and hunting in other areas, and parts are used for bombing exercises.
Waterfowl: An important area for a variety of breeding, passage and wintering waterfowl. *Pelecanus occidentalis* breeds on a small offshore island (60 pairs in 1978); there

are large roosts of Ardeidae at Playa Grande Lagoon and Tapon Bay; *Dendrocygna arborea* occurs at the Kiani Lagoons; and there are large resident populations of *Anas bahamensis*, *Himantopus himantopus* and several species of Laridae. *Anas discors* and many shorebirds are common on passage and in winter.

Other fauna: The Yellow-shouldered Blackbird *Agelaius xanthomus* breeds, *Falco peregrinus* occurs in winter, and there are large colonies of sea-birds on some of the offshore islets. The manatee *Trichechus manatus* is known from the northwest and south coasts, the sea turtles *Dermochelys coriacea* and *Eretmochelys imbricata* nest on the beaches, and *Chelonia mydas* frequents offshore reefs.

Threats: The use of the area for naval target practice causes some disturbance, but there is no serious threat as long as the U.S. Navy maintains control over large parts of the island. However, were the Navy to pull out, it is likely that the island would be subject to rapid development for tourism and industry.

References: Baker (1979); Raffaele (1979a); Schreiber *et al* (1981); Moreno *et al* (1983); Chabert *et al* (1984).

Source: See references.

Criteria for inclusion: 2a, 2b & 3a.

Wetlands on Culebra Island (15)

Location: 18°20'N, 65°18'W; in Vieques Passage, halfway between the Puerto Rican mainland and St. Thomas (U.S. Virgin Islands), Culebra Municipality.

Area: Several hundred ha.

Altitude: 0-5m.

Province and type: 8.40.13; 03, 04, 05, 07 & 08.

Site description: A number of shallow brackish to saline lagoons and mangrove swamps on the small island of Culebra, and about eighteen offshore cays. The principal wetlands are Flamenco Lagoon, Zoni Lagoon, mangrove swamps at Los Caños, and Cornelius Lagoon.

Principal vegetation: Mangrove swamps; dry thorn scrub inland.

Land tenure: Privately owned.

Protection: Wetlands on the island are unprotected, but all the surrounding cays except Cayo Norte are included in the Culebra National Wildlife Refuge (284 ha) established in 1909.

Land use: Very little disturbance; there is some boat traffic and illegal collection of eggs and chicks of nesting sea-birds.

Waterfowl: The most important area in Puerto Rico for *Anas bahamensis*. Up to 400 have been recorded on Flamenco Lagoon, and large numbers also occur on Zoni Lagoon and Cornelius Lagoon. Other breeding birds include *Himantopus himantopus*, *Larus atricilla* and *Sterna hirundo*. *Pelecanus occidentalis* is a common non-breeding visitor, and many shorebirds and Laridae occur on passage and in winter.

Other fauna: There are important sea-bird colonies on several of the offshore cays and on Flamenco Peninsula. The sea-turtles *Dermochelys coriacea* and *Eretmochelys imbricata* nest on the beaches.

Threats: Poaching at the sea-bird colonies, disturbance from boat traffic, and predation from introduced cats and rats are the only threats at present.

References: Raffaele (1979a); IUCN (1982); Moreno *et al* (1983); Chabert *et al* (1984).

Source: See references.

Criteria for inclusion: 2b & 3a.

SAINT KITTS-NEVIS

INTRODUCTION

No information was received on the current situation in St. Kitts-Nevis. The following account is based on Putney (1982), IUCN (1983) and Goodwin *et al* (1984).

Saint Kitts (or Saint Christopher, as it is more properly known) and Nevis are mountainous volcanic islands rising to peaks of 1,315m and 1,096m respectively, in the Leeward Islands of the Lesser Antilles. The two islands have a combined area of about 265 km^2 and are separated by a narrow channel less than four kilometres wide. Formerly a British Crown Colony, the islands became independent in 1983. Almost three-quarters of the population of 49,000 live on Saint Kitts. The economy relies heavily on the cultivation of sugar cane, and the tourist industry has only recently begun to be important.

The climate is tropical, an average annual rainfall of 2,500 mm to 4,000 mm in the highlands supporting rain and cloud forest. In the drier lowlands, much of the native woodland and cactus scrub has been cleared for agriculture and livestock grazing. There are nine salt ponds and several patches of mangroves of importance for waterfowl, particularly migratory shorebirds, in the southern half of St. Kitts, but no wetlands of any significance on Nevis. Both islands have many sand beaches and extensive offshore coral reefs and sea-grass beds with important marine resources.

No information is available on the governmental conservation body in St. Kitts-Nevis. The Nevis Historical and Conservation Society, a non-governmental body created in 1980, is dedicated to the protection and preservation of the island's natural resources and architectural and historic heritage. According to Putney (1982), only one protected area had been established in the islands prior to 1982 and this, a small reserve near the west end of St. Kitts, did not include any wetland habitat. However, four areas were proposed for protection and one of these, incorporating the whole of the southeast peninsula of St. Kitts, included the island's largest wetland, Great Salt Pond, and several smaller salt ponds.

WETLANDS

No recent information is available on the wetlands of Saint Kitts and Nevis. The following site descriptions are based on Putney (1982), Goodwin *et al* (1984), and some waterfowl counts made by Edouard Benito-Espinal in September 1982. (For map, see Dominica.)

Greatheeds Pond (1)

Location: 17°20'N, 62°42'W; on the east coast of St. Kitts, NNE of Basseterre.
Area: c.30 ha.
Altitude: Near sea level.
Province and type: 8.41.13; 05, 07 & 08.
Site description: A small saline lagoon surrounded by mangrove swamps, behind a sea beach.
Principal vegetation: Mangrove swamps dominated by *Laguncularia racemosa*; sugar cane fields and secondary vegetation in surrounding areas.
Land tenure: Public land (state owned).
Protection: None.
Land use: Disposal of solid waste; cultivation in surrounding areas.
Waterfowl: A breeding area for *Nyctanassa violacea*, *Larus atricilla* and probably other species, and an important feeding area for migratory shorebirds. 350 shorebirds were observed during a brief survey in September 1982, mainly *Pluvialis squatarola*, *Charadrius semipalmatus*, *Calidris pusilla* and *Micropalama himantopus*.
Other fauna: No information.
Threats: The southern border of the pond abuts the island's main rubbish dump, and this must have a significant effect on the ecology of the pond.
References: Putney (1982); Goodwin *et al* (1984).
Source: Edouard Benito-Espinal.
Criteria for inclusion: 3a.

Half Moon Pond (2)

Location: 17°19'N, 62°42'W; on the east coast of St. Kitts, northeast of Basseterre.
Area: 17 ha.
Altitude: Near sea level.
Province and type: 8.41.13; 05, 07 & 08.
Site description: A permanent saline lagoon, up to 50 cm deep, and mangrove swamps behind a sea beach. Impoundments have been constructed in the pond for shrimp farming. A salinity of 184 p.p.t. was recorded in November 1983.
Principal vegetation: Mangroves; *Coccoloba uvifera*, coconut palms and scrub along the beach; coconut groves and sugar cane fields to the north.
Land tenure: Privately owned and leased to a shrimp farming company.
Protection: None.
Land use: Commercial shrimp farming.
Waterfowl: An important feeding area for migratory shorebirds; over 660 were present in September 1982, mainly *Calidris pusilla* (over 500), *Tringa flavipes* and *Himantopus himantopus*.
Other fauna: Brine shrimps *Artemia* sp occur in the pond.
Threats: There is some pollution from domestic waste. The entire ecology of the pond has been changed with the shrimp farming activities; sea water is now pumped into the shrimp ponds and inorganic fertilizers are applied.
References: Putney (1982); Goodwin *et al* (1984).
Source: Edouard Benito-Espinal.
Criteria for inclusion: 0.

Muddy Pond (3)

Location: 17°18'N, 62°41'W; on the east coast of St. Kitts, east of Basseterre.
Area: c.30 ha.
Altitude: Near sea level.
Province and type: 8.41.13; 05 & 07.
Site description: A small saline lagoon with some brackish marshes, behind a sea beach.
Principal vegetation: Secondary vegetation in surrounding areas.
Land tenure: Public land (state owned).
Protection: None.
Land use: None.
Waterfowl: An important feeding area for Ardeidae and migratory shorebirds. Species recorded in September 1982 included *Nyctanassa violacea, Butorides virescens, Egretta caerulea, E. thula, E. alba, Anas discors* and six species of shorebirds.
Other fauna: No information.
Threats: None known.
References: Putney (1982).
Source: Edouard Benito-Espinal.
Criteria for inclusion: 0.

Great Salt Pond and nearby ponds (4)

Location: 17°14'N, 62°39'W; on the southeast peninsula of St. Kitts.
Area: c.275 ha (Great Salt Pond, 203 ha).
Altitude: Near sea level.
Province and type: 8.41.13; 05, 07 & 08.
Site description: A large saline lagoon (Great Salt Pond), up to 1.2m deep, in the interior of the southeast peninsula of St. Kitts, and four small saline ponds (Friar's Bay Pond, Little Salt Pond, Major's Bay Pond and Cockleshell Pond) behind sea beaches. The ponds have muddy shorelines and there are small patches of mangroves at Friar's Bay Pond, at Little Salt Pond, and on the northeast shore of Great Salt Pond. Great Salt Pond and Little Salt Pond (23 ha) are part of an old salt producing facility; Little Salt Pond is separated from Great Salt Pond by a dike, and appears to be fed by a fresh or brackish spring. Salinities of 230 p.p.t. and 72 p.p.t. were recorded at Great and Little Salt Ponds respectively in November 1983.
Principal vegetation: Mangrove swamps; littoral vegetation and cactus scrub in surrounding areas, and sea-grass beds offshore.
Land tenure: Privately owned.
Protection: None.
Land use: Some tourism, and lobster and conch fishing offshore; the peninsula remains largely unspoiled.
Waterfowl: An important feeding area for shorebirds and Laridae. Sixteen species were recorded during a brief survey in September 1982 including *Tringa flavipes* (230), *Calidris pusilla* (590), *Micropalama himantopus* (56) and *Himantopus himantopus* (110).
Other fauna: The brine shrimp *Artemia* sp occurs in Great Salt Pond. There is a breeding colony of *Fregata magnificens* to the south of Little Salt Pond. Five beaches around the peninsula provide nesting areas for the sea turtles *Chelonia mydas, Dermochelys coriacea* and *Eretmochelys imbricata*, and there are extensive coral reefs offshore.
Threats: There is some seaborne pollution on the north shore of the peninsula.
Research and conservation: Great Salt Pond is one of the largest remaining unspoiled salt ponds in the Lesser Antilles. The southeast peninsula of St. Kitts has been identified by Putney as an area with multiple resource values and a priority area for protection. The entire peninsula has been proposed as a protected area.
References: Putney (1982); Goodwin *et al* (1984).
Source: Edouard Benito-Espinal.
Criteria for inclusion: 3a.

SAINT LUCIA

INTRODUCTION

by **Gabriel L. Charles and Paul Butler**

Saint Lucia, one of the Windward Islands in the Lesser Antilles, is a forest clad volcanic island of 616 km^2 in extent with mountains rising to 960m. The tropical climate is dominated by the almost constant influence of the northeast trade winds. There is a dry season from January to April, and a rainy season from May to August. The annual rainfall varies around the island from 1,500 to 3,500 mm.

St. Lucia became a fully independent member of the British Commonwealth in February 1979. The population of about 120,000 has an economy based on tourism and agricultural production, particularly bananas. There is some industry and an oil transhipment terminal.

The few wetland areas are mostly coastal mangrove swamps. Although of rather limited extent, the wetlands serve several vital functions including: (1) nursery sites for a variety of fish species which populate the reef areas and support a small fishing industry; (2) staging areas for Anatidae and shorebirds migrating through the eastern Caribbean; and (3) areas for environmental education and recreation.

The most important wetland sites are as follows:

Bois d'Orange (freshwater swamp)
Esperance (mangrove swamp and tidal mudflats)
Marigot Bay (mangrove swamp and lagoon)
Marquis (mangrove swamp and lagoon)
Praslin (mangrove swamp and tidal mudflats)
Savannes Bay (mangrove swamp and lagoon)
St Urbain/Marigot/Boriel's Pond (mangrove swamp and lagoon)
Trougascon (mangrove swamp and lagoon)
Volet (mangrove swamp and tidal mudflats)

Resident waterfowl include several herons and egrets (Ardeidae) and rails (Rallidae); regular migrants and winter visitors include six species of Nearctic ducks and seventeen species of shorebirds.

Institutional Base for Wetland Conservation and Research

The principal body concerned with conservation in St. Lucia is the Forestry Division of the Ministry of Agriculture in Castries. The wildlife conservation work of the Forestry Division involves an integration of three components: effective legislation; initiation of environmental education; and establishment of nature reserves and protected areas.

The St. Lucia Naturalists' Society is a non-governmental organization with a membership of about 120. It promotes wildlife conservation and in particular strives to increase conservation awareness amongst school children.

Progress in Wetland Conservation and Research

The protection of the State's terrestrial wildlife falls under the broad umbrella of the Forestry Division's Wildlife Protection Ordinance. This is subdivided into "Absolutely Protected", "Partially Protected" and "Unprotected" schedules. Subsequent to the devastating hurricane of 1980, all species listed in the Partially Protected schedule were upgraded to Absolutely Protected and at present, the only species that may be shot are mongoose *Herpestes auropunctatus*, rats, mice and Fer-de-lance *Trimeresurus atrox* (pest species). Knowledge of the Ordinance is widespread amongst the population, and to date there have been very few legal infringements. Most of these have involved the collection or possession of reptile species.

In its environmental education programme, the Forestry Division regularly holds film shows and publishes articles in the press. Visual aids such as billboards, posters and T-shirts have also featured in its work. The Division has published a booklet entitled the A-Z of St. Lucia's Wildlife, and this was distributed to the Ministry of Education. A second series on the A-Z of trees was published in the national newspaper. A monthly environmental broadsheet entitled "Bush Talk" is produced, and this examines a wide range of topics including national, cultural and historical conservation. "Bush Talk" is sent to schools islandwide and is simultaneously published in the newspaper. If funds can be located, it is hoped to publish "Bush Talk" in book form for permanent use by school children.

Within the Division's Forest Reserve, an area of approximately 650 ha has been set aside as a reserve to protect the St. Lucia Parrot *Amazona versicolor*, St. Lucia's national bird, as well as other forest wildlife. Two small islets lying off the southeast coast of St. Lucia, the Maria Islands, have been declared a Nature Reserve to protect the Maria Island Lizard and the Maria Island Snake, both species endemic to the 12 hectares which the islands comprise. An area of mangroves at Savannes Bay, on the southeast coast near Micoud, has been declared a Nature Reserve, but funds are lacking for its development. Other areas recommended for protection include Marigot Bay (mangroves), The Pitons (scenic interest), Bois d'Orange Swamp (freshwater swamp), and Dennery Knob, but official recognition of these and development funds have yet to be obtained. In line with this, efforts are being made to undertake baseline studies of mangrove swamps and other wetland habitats.

St. Lucia is actively involved in regional and international efforts, including the work of the Caribbean Conservation Association. St. Lucia is a signatory of the Convention on International Trade in Endangered Species (CITES), and as such is committed to the international conservation of threatened species. Conservation priorities on the island have recently been reviewed by Putney (1982).

Because of limited financial and manpower resources, research to date has concentrated on studies of endemic wildlife such as the St. Lucia Parrot, and very little work has been done on the wetlands or their wildlife. However, the importance of the coastal mangroves as nurseries for fisheries is now appreciated. While a considerable amount of research has been conducted in extensive mangrove areas elsewhere in the Caribbean, this work may not be directly applicable to the small patches occurring in St. Lucia and around many other islands in the Lesser Antilles, and research here is clearly a high priority.

Major Threats to Wetlands

Because of the shortage of land and the intense human population pressure, most of the wetlands of St. Lucia are seriously threatened. The one freshwater swamp is threatened with drainage, while the mangrove areas are being cut down for timber, destroyed for housing, hotel and marina development, polluted with domestic waste, or used as rubbish dumps.

WETLANDS

Site descriptions taken from a report entitled "Conservation of Wetlands and Wildfowl in Saint Lucia", prepared by Gabriel L. Charles and Paul Butler of the Forestry Division of the Ministry of Agriculture. (For map, see Dominica.)

Bois d'Orange Swamp (1)

Location: 14°03'N, 60°58'W; 6 km north of Castries.
Area: 12-16 ha.
Altitude: 0-2m.
Province and type: 8.41.13; 13.
Site description: A small freshwater swamp prone to periodic flooding during the rainy season, when small lakes and ponds appear. The only significant freshwater swamp in Saint Lucia.
Principal vegetation: Rushes and sedges with scattered trees; the wetland is surrounded by dry wooded hills.
Land tenure: Privately owned (three owners).
Protection: None.
Land use: Cattle grazing on one third of the area in the dry season; several small farms, a quarry and a hotel nearby.
Waterfowl: An important area during the rainy season for a variety of migratory waterfowl. Several species of Ardeidae are resident, and *Gallinula chloropus* breeds.
Other fauna: No information.
Threats: The swamp is gradually being drained to provide land for housing. Several drainage ditches have been dug, and the water level has dropped, resulting in a spread of grasses and shrubs. The small river feeding the swamp is badly polluted with domestic sewage and rubbish.
Research and conservation: The Forestry Division has recommended that the area be purchased and managed as an Educational Nature Reserve, with raised walkways, observation hides, and facilities for interpretation and interaction between environment, teacher and student. No funds are however as yet available.
References: Forestry Division (1984).
Source: Gabriel L. Charles and Paul Butler.
Criteria for inclusion: 2b & 3a.

Marigot Bay (2)

Location: 13°59'N, 61°01'W; on the west coast 7 km south of Castries.
Area: c.100 ha.
Altitude: 0m.
Province and type: 8.41.13; 01, 05 & 08.
Site description: A shallow sea bay with fringing mangrove swamps and sandy beaches.
Principal vegetation: Mangrove swamps with *Rhizophora mangle* and *Avicennia* sp. Scrub and secondary forest on adjacent hillsides.
Land tenure: The mangroves are state owned; the adjacent coast is privately owned.
Protection: None.
Land use: Tourist recreation, mainly water sports. One side of the bay has been divided up for expensive housing development, and there is a small hotel on the other side.
Waterfowl: Particularly important for resident Ardeidae and migratory shorebirds.
Other fauna: The Hawksbill Turtle *Eretmochelys imbricata* may breed on the beaches.
Threats: The mangrove is under threat from hotel development and pollution from the large number of private yachts which anchor in the bay. The bay is gradually silting up as a result of soil erosion on the surrounding hillsides.
Research and conservation: The bay is recognized as an area of outstanding scenic beauty, and has tremendous potential for tourism. The Forestry Division has drawn up a management plan for the development of a small nature reserve complete with interpretive facilities and guided walks. One of the landowners in the area has offered an initial plot of land free to the

Government to form the basis for a nature reserve. The mangroves lie within the Government's own "Queen's Chain", and could easily be included in any reserve established. Additional lands may be donated to the Government at a later date.
References: Putney (1982); Forestry Division (1984).
Source: Gabriel L. Charles and Paul Butler.
Criteria for inclusion: 3a.

Savannes Bay and Boriel's Pond (3)

Location: 13°46'N, 60°55'W; on the southeast coast 5 km north of Vieux Fort.
Area: c.200 ha.
Altitude: 0m.
Province and type: 8.41.13; 01, 06, 07 & 08.
Site description: A shallow sea bay with coral reefs, sea-grass beds and extensive mangrove swamps; and a nearby shallow saline lagoon with surrounding mudflats.
Principal vegetation: Mangrove swamps, mainly *Rhizophora mangle*; and sea-grass beds.
Land tenure: Partly state owned, and partly privately owned.
Protection: The area owned by the State has been vested in the Saint Lucia National Trust, which has drawn up proposals for the conservation of the area. The remainder is unprotected.
Land use: Tourist recreation and some subsistence fishing.
Waterfowl: An important area for resident Ardeidae and migratory waterfowl. Boriel's Pond is particularly important for migratory Anatidae and shorebirds.
Other fauna: The bay is an important nursery ground for large numbers of commercially important crustaceans and fishes.
Threats: None at present.
Research and conservation: A number of specific proposals for the conservation of the area have been drawn up and are listed in the interim report of the South-East Coast Management Plan prepared by ECNAMP and an *ad hoc* Committee including the Forestry Division. The proposals revolve around maintaining the area in its pristine condition, and allowing only traditional forms of subsistence fishing.
References: Putney (1982); Forestry Division (1984).
Source: Gabriel L. Charles and Paul Butler.
Criteria for inclusion: 2c & 3a.

SAINT VINCENT

INTRODUCTION

No report was received on the current situation in Saint Vincent or its dependencies in the Grenadines. The following account is based on some material provided by Byron Swift of WWF-US and the literature, principally Putney (1982).

Saint Vincent is a volcanic island 344 km^2 in extent in the southern Windward Islands, between Saint Lucia and Grenada. It became fully independent in 1979, and has a population of some 113,000. The Grenadine Islands, a string of tiny rocky islands stretching for 100 km between Saint Vincent and Grenada, are divided politically between the two. The northern group, including the main islands of Bequia, Mustique, Cannouan and Union, and some twenty-eight islets and rocks, are dependencies of Saint Vincent.

Saint Vincent is very rugged and mountainous, rising to a peak of 1,219m on Soufriere Mountain, an active volcano with a crater lake over 500m down inside the crater. The climate is humid tropical; the average annual rainfall exceeds 6,000 mm in the highlands and supports luxuriant rain and cloud forest. Most of the lowlands have been cleared for agriculture, especially bananas and arrowroot, and there is some tourist development, particularly in the south. The Grenadines are low limestone islands rising to a maximum elevation of 300m. Rainfall is much less than on Saint Vincent, and the dominant vegetation is cactus scrub and dry woodland.

Except for the hot crater lake on Soufriere, there are no wetlands of any great size in the islands. Waterfowl are scarce; for example, during short surveys in March and July 1971, Lack *et al* (1973) recorded only five species. *Bubulcus ibis* is a common resident and thereare small resident populations of *Butorides virescens* and *Egretta caerulea*. *Anas discors* and shorebirds are hunted during the migration seasons, and many other migrants occur, but numbers are small. There are many beaches with nesting sea turtles *Caretta caretta, Chelonia mydas, Dermochelys coriacea* and *Eretmochelys imbricata*, small islets with sea-bird colonies and patches of coral reef throughout the islands.

The governmental body concerned with conservation in Saint Vincent is the Forestry Department within the Ministry of Agriculture. Four small protected areas have been established on Saint Vincent; two in the interior near the south end of the island, and two on tiny offshore islets. One of these, Milligan Cay, is an important roosting area and probably a breeding site for Ardeidae. Four small protected areas have been established in the Saint Vincent Grenadines, all in the interior of Union. Areas proposed for protection include a large tract of the forested highland, Young's Island off the south coast, and the Tobago Cays in the Grenadines.

WWF-US has recently assisted the Government of Saint Vincent in drawing up a new wildlife law. Still in draft version, this new law would provide the basis for the establishment of wildlife refuges and would give complete protection to all wildlife except for a few game species (Anatidae, Columbidae, etc.). Schedule III of the draft version lists fifteen sites for protection as wildlife refuges. Most are small islands of importance for breeding sea-birds, but several, including Milligan Cay and Chateaubelair Islet, are known or thought to be important for Ardeidae.

WETLANDS

Very little information is available on the wetlands of Saint Vincent and the northern Grenadines. Descriptions of the three main wetlands are based almost entirely on Putney (1982). Other wetlands, probably of only local importance, include: a small salt pond near Owia Bay, at the northeast tip of Saint Vincent; a small mangrove swamp near Black Point on the east coast of Saint Vincent; three small salt ponds near the south end of Cannouan Island; and a small salt pond on Mayero Island. Chateaubelair Island, off Saint Vincent's west coast, may be an important roosting site for Ardeidae. (For map, see Dominica.)

Soufriere Crater Lake (1)

Location: 13°20'N, 61°11'W; in the Soufriere Mountains, in the northern highlands of Saint Vincent.
Area: c.900 ha.
Altitude: c.500m.
Province and type: 8.41.13; 12.
Site description: A crater lake with hot water, 500m down inside a volcanic crater on Soufriere Mountain. An island rose above the surface of the lake in 1970.
Principal vegetation: Cloud forest and secondary vegetation in surrounding areas.
Land tenure: Public land (state owned).
Protection: None, but all land over 305 m on the island is protected as forest use land.
Land use: None.
Waterfowl: No information.
Other fauna: No information.
Threats: None known.
Research and conservation: The lake lies within a large proposed protected area which incorporates much of the forested highlands of Saint Vincent.
References: Putney (1982).
Source: See references.
Criteria for inclusion: 3b.

South coast wetlands and Milligan Cay (2)

Location: 13°08'N, 61°11'W; on the south coast of Saint Vincent, between Brighton Bay and Sharp's Bay.
Area: c.100 ha.
Altitude: Near sea level.
Province and type: 8.41.13; 01, 03, 05, 07 & 08.
Site description: Two small coastal mangrove swamps near Sharp's Bay and in Nilikin's Bay respectively, a small saline pond to the east of Nilikin's Bay, some sand beaches, and an offshore cay, Milligan Cay, to the east.
Principal vegetation: Mangroves; some cactus scrub in surrounding areas.
Land tenure: Milligan Cay is public land (state owned); other areas are privately owned.
Protection: Milligan Cay is protected in a small reserve; other areas are unprotected.
Land use: There is considerable urban and suburban development along the coast.
Waterfowl: Milligan Cay is an important roosting site and probably a breeding site for Ardeidae, particularly *Bubulcus ibis* (hundreds) and *Egretta caerulea* (Byron Swift, pers. com.).
Other fauna: There is a sea-bird colony on Milligan Cay.
Threats: No information.
References: Putney (1982).
Source: See references.
Criteria for inclusion: 3a.

Union Island Mangroves (3)

Location: 12°35'N, 61°26'W; on the south coast of Union Island, in the Grenadines.
Area: A few ha.
Altitude: 0m.
Province and type: 8.41.13; 08.
Site description: A small coastal mangrove swamp and associated saline marshes; the only significant wetland in the northern Grenadines.
Principal vegetation: Mangroves.
Land tenure: No information.
Protection: None.
Land use: There is some cultivation and tourism on the island.
Waterfowl: No information.
Other fauna: There are coral reefs offshore.
Threats: Seaborne pollution on the nearby coast.
References: Putney (1982).
Source: See references.
Criteria for inclusion: 0.

TURKS AND CAICOS ISLANDS

INTRODUCTION

No report was received on the current situation in the Turks and Caicos Islands. The following account is based on a list of wetlands provided by C.H. Floyd, Director of Planning in the Ministry of Commerce and Development of Industries and Resources, and on the literature, principally IUCN (1982 & 1983).

The Turks and Caicos Islands comprise a British Crown Colony of about thirty low-lying islands to the southeast of the Bahamas and some 200 km north of the Hispaniolan coast. The Turks and Caicos groups are separated by the Turks Island Passage, a 35 km wide channel over 2,100m deep. The total land area is only 500 sq. km, but both groups are surrounded by extensive shoal sand banks, the Turk Island Bank of 254 sq. km and the Caicos Bank of 5,334 sq. km. Almost half of the islands' population of nearly 8,000 live in the smaller Turks group, and only thirteen of the islands are inhabited. Until recently, the islands remained almost undeveloped and unspoiled, the inhabitants depending largely on fishing for lobster and conch, but the tourist industry is now expanding rapidly, particularly on Providenciales, the most westerly of the inhabited islands.

Institutional Base for Wetland Conservation and Research

There is no government department specifically responsible for the conservation of wildlife or protected areas; parks are under the responsibility of the Chief Minister subject to review by the British Governor, and marine reserves are controlled through the Fisheries Department. Relevant legislation is enforceable through the Fisheries Department and the Department of Public Works.

Non-governmental conservation bodies include the Foundation for PRIDE, incorporated in 1976 in Washington, D.C., U.S.A., and operating out of a field headquarters in Turks and Caicos, and the Turks and Caicos National Trust, created in 1981. Both are concerned with broad conservation issues. The Foundation for PRIDE has concentrated on the development of alternative energy producing devices, the management of marine resources and the development of marine parks.

Progress in Wetland Conservation and Research

The National Parks Ordinance and Regulations were approved in 1976, and a Temporary National Parks Commission designated a large number of terrestrial and marine national parks, national reserves and wildlife sanctuaries. Many of these incorporate important wetland habitat, but whether or not any have has yet been officially gazetted is unknown.

The Wild Birds Protection Ordinance of 1916 gives complete protection to all birds except for a few pest species (including Laridae) and a variety of game species (including *Pelecanus*, Anatidae, Charadriidae and *Gallinago*) for which an eight months open season is allowed.

It is understood that the Government is embarking on a major ecological conservation study in July 1985, but the details are unknown.

WETLANDS

A list of wetlands in the Turks and Caicos Islands prepared by C.H. Floyd includes no less than 110 sites with a total area of 26,669 ha, over half of the surface area of the islands. The wetlands are distributed as follows:

Grand Turk: 419 ha of wetlands
    North Creek, 149 ha
    Town Pond, 85 ha
    Great Salinas, 39 ha
    The Sound and South Creek, 49 ha
    Hawke's Nest Salinas, 40 ha
    Six wetlands of less than 20 ha

Salt Cay: 164 ha of wetlands
    Town Salinas, 101 ha
    Five wetlands of less than 20 ha

Turks Cays: 4.5 ha of wetlands in three sites

South Caicos: 427 ha of wetlands
    Victoria Salina, 346 ha
    Basden Pond, 22 ha
    Mangrove, 23 ha
    Four wetlands of less than 20 ha

Middle Caicos: 7,297 ha of wetlands
    Fish Ponds, 1,377 ha
    Flamingo Pond, 28 ha
    Armstrong Pond and Swamp, 1,120 ha
    Farm Creek Pond, 250 ha
    Big Pond and Lagoons, 2.984 ha
    Eel Pond and Swamp, 150 ha
    Increase Creek, 219 ha
    Finaway Creek, 524 ha
    Jack Pond, 229 ha
    The Creek and Swamp, 350 ha
    Fourteen wetlands of less than 20 ha

North Caicos: 4,888 ha of wetlands
    Flamingo Pond, 3,113 ha
    Whitby Salina, 30 ha
    Pumpkin Bluff Pond, 177 ha
    Mally Pond, 21 ha
    Monacah Salina, 30 ha
    Conch Cay Salina, 71 ha
    Bay Cay Salina, 830 ha
    Sawgrass Pond, 45 ha
    Mud Hole Pond, 77 ha
    Mangrove Pond, 31 ha
    Dick Hill Creek, 392 ha
    Nine wetlands of less than 20 ha

Providenciales: 3,830 ha of wetlands
    Cheshire Hall Creek, 150 ha
    Pigeon Pond and Salina, 179 ha
    Frenchmen's Creek, 1,326 ha
    Chalk Sound, 978 ha
    Stubbs Creek, 65 ha
    Corrinice Ponds, 36 ha

Davy Bight Pond, 28 ha
South Dock Road Pond and Swamp, 36 ha
Fish Pond and Swamp, 64 ha
Juba Point Salina, 661 ha
The Bight Swamp, 142 ha
Mangrove Creek, 85 ha
Eight wetlands of less than 20 ha

East Caicos: 8,546 ha of wetlands
Salt Pond, 38 ha
Flamingo Pond, 63 ha
Flamingo Hill (Scatter Swamps), 582 ha
White Salina Bank, 7,810 ha
Six wetlands of less than 20 ha

Caicos Cays: 598 ha of wetlands
Pine Cay, 59 ha
Water Cay, 85 ha
Dellis Cay, 111 ha
Parrot Cay, 343 ha

West Caicos: 497 ha of wetlands
Lake Catherine, 118 ha
East Side Bay Salina, 356 ha
Three wetlands of less than 20 ha

In addition, there are over 38,000 ha of intertidal sand banks and mudflats, mainly along the south coasts of North, Middle and East Caicos Islands. No further information is available on these wetlands.

UNITED STATES VIRGIN ISLANDS

INTRODUCTION

by **Robert L. Norton**

The Virgin Islands are a group of small islands situated between Puerto Rico and the Leeward Islands. Politically they are divided into two groups: the larger western group constituting the U.S. Virgin Islands and the smaller eastern group a British Crown Colony. The U.S. Virgin Islands contain three main islands, St. Thomas, St. John and St. Croix, and a large number of small offshore islets and cays. The total area of the group is 345 km^2 and the population about 95,000. The islands were purchased from Denmark by the U.S.A. in 1917 and remain a U.S. Territory.

The climate of the islands is dominated by the influence of the trade winds, and average temperatures vary little between winter (25°C) and summer (28°C). The islands have long been developed for tourism and this is now the major industry, particularly on St. Thomas. Agriculture and cattle ranching remain important, especially on St. Croix where there is also some industry, including the largest oil refinery in the Western Hemisphere. St. John, with a population of only about 3,000, remains the least developed of the main islands. About two-thirds of this island is a U.S. National Park.

The topography of the three main islands is hilly, with peaks rising to 474m. The orginal forests have been almost completely destroyed, and most of the existing forest and scrub is secondary with a large component of introduced species. There are some wetlands on all three of the main islands; most are shallow sea bays or brackish to saline coastal ponds with mangrove swamps, and all are small in size.

Institutional Base for Wetland Conservation and Research

The following institutions are concerned with conservation and/or research in the U.S. Virgin Islands:

The Division of Fish and Wildlife, in the Department of Conservation and Cultural Affairs, US Virgin Islands Government; based on St. Thomas, with an office on St. Croix.

Coastal Zone Management (CZM), in the Department of Conservation and Cultural Affairs, with its main office on St. Croix; CZM has jurisdiction over all wetlands.

The Island Resources Foundation; a non-governmental organization based on St. Thomas. The Foundation is concerned with improvement of resource management strategies in the islands, and provides special environmental guidelines for development projects.

The Caribbean Research Institute and Virgin Islands Ecological Research Station, both connected with the College of the Virgin Islands.

The West Indies Laboratory of Fairleigh Dickinson University, on St. Croix.

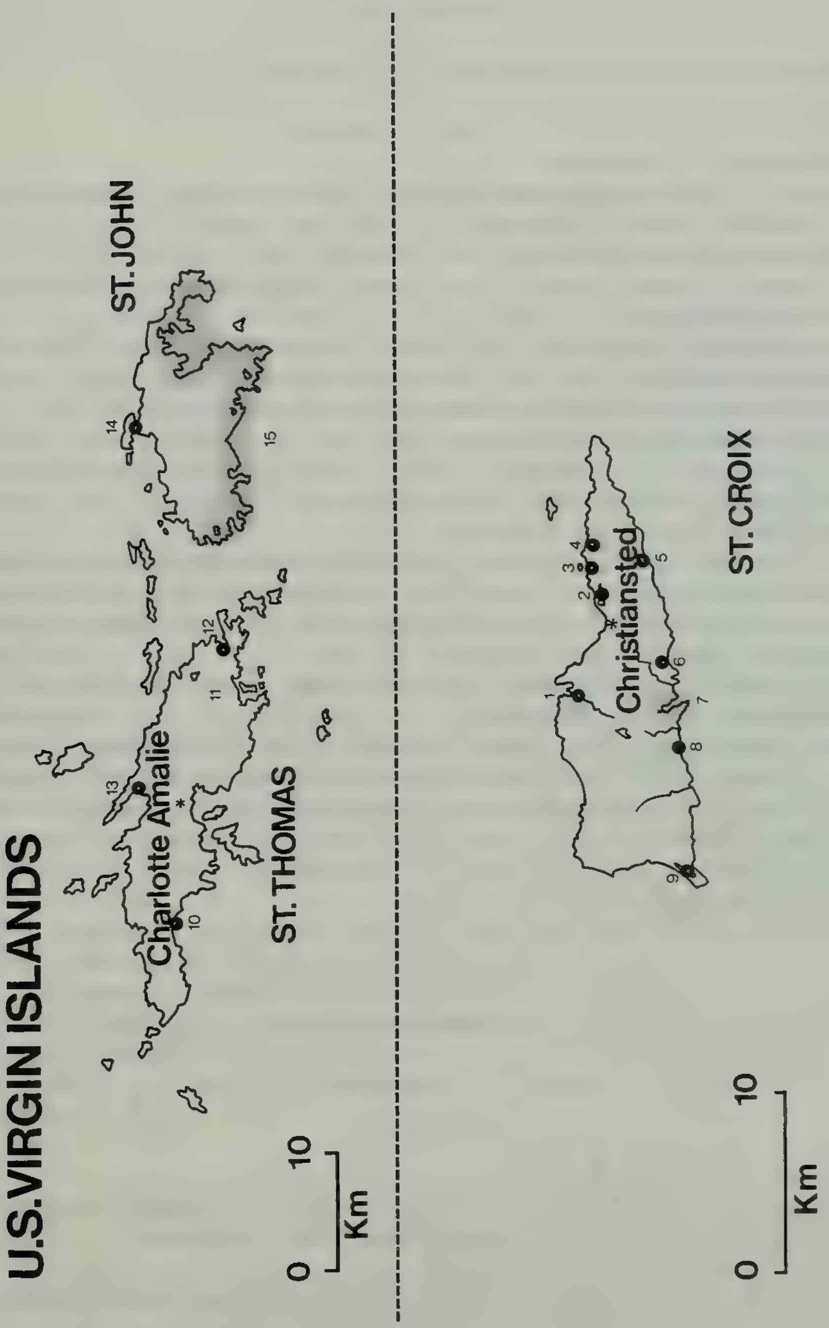
Progress in Wetland Conservation and Research

Progress to date has been limited to the establishment of island reserves some of which contain wetland habitat. The most notable of these is the Virgin Islands National Park (6,073 ha) on St. John, which incorporates the most important wetland on that island and three other small ponds. The concept that wetlands are protected under the jurisdiction of Coastal Zone Management has been generally accepted, although enforcement of the concept and the laws protecting wetland vegetation and wetlands is lagging behind efforts in the continental United States. Insufficient funding and personnel are operational causes, and lack of public awareness or commitment is the result.

The Division of Fish and Wildlife was granted a contract to survey shorebirds in the U.S. Virgin Islands between 1981 and 1983. However, Federal budget cuts reduced the period of the survey to one year rather than three. Another short project attempted to define some of the characteristics of duck habitat in the islands. The results of both projects are as yet unpublished. A waterfowl banding programme is currently underway to determine the extent of inter-island movements and habitat use. About 100 shorebirds have been banded in the programme to date.

Major Threats to Wetlands and Waterfowl

The major threats to wetlands are filling and/or dredging for commercial ventures by either the local Virgin Islands Government or private business. Waterfowl are subject to loss of habitat and destruction from various sources. The recent dumping of old automobiles on the mudflats of Mangrove Lagoon, St. Thomas, has had a detrimental effect on nesting areas for *Charadrius wilsonius* and *C. vociferus* as well as roosting areas for *Larus atricilla* and migratory shorebirds. The quality of the substrate for the invertebrate fauna of the sand and mudflats has probably also been altered by the drainage of automobile fluids, etc. Waterfowl are also hunted out of season and harassed by stray dogs, cats and perhaps the introduced mongoose *Herpestes auropunctatus*.


U.S.VIRGIN ISLANDS
ST. JOHN
ST. THOMAS
Charlotte Amalie
ST. CROIX
Christiansted
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
0
10
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Km

WETLANDS

Site descriptions based on data sheets provided by Robert L. Norton and Fred W. Sladen of the Division of Fish and Wildlife.

Salt River Bay (1)

Location: 17°47'N, 64°45'W; 6 km northwest of Christiansted, St. Croix.
Area: 100 ha.
Altitude: 0m.
Province and type: 8.41.13; 02 & 08.
Site description: A shallow tidal estuarine bay, up to 2m deep, with fringing mangrove swamps; the mouth of the bay is protected by a coral reef. Salinities range from 30-40 p.p.t.
Principal vegetation: Mangrove swamps with *Avicennia germinans* and *Rhizophora mangle.*
Land tenure: Mainly privately owned. The Nature Conservancy owns a section of mangrove swamp with nesting Ardeidae.
Protection: Under the jurisdiction of Coastal Zone Management, U.S. Virgin Islands Government, and designated in 1980 as a National Natural Landmark. A section of the mangrove swamps is protected by the Nature Conservancy.
Land use: Fishing and recreational boating.
Waterfowl: A nesting site for *Nyctanassa violacea, Butorides virescens* and *Egrettacaerulea*, and a feeding and roosting site for *Pelecanus occidentalis*, five species of Ardeidae and many shorebirds (including *Haematopus palliatus*).
Other fauna: The mangroves constitute a very important feeding area for many species of Parulidae during migration and in winter, and *Dendroica petechia* is a resident breeder. The White-crowned Pigeon *Columba leucocephala* also breeds. The wetland is a major nursery ground for dozens of species of marine fauna.
Threats: The wetland is threatened by the development of two marinas, the construction of private dwellings, and hotel development.
Research and conservation: The wetland was identified by Baker as a priority area for protection. A nearby Marine Hydrolaboratory, incorporating underwater habitat in about 20m of water off the mouth of the bay, is used for research in marine sciences.
References: Baker (1980).
Source: Fred W. Sladen.
Criteria for inclusion: 2b & 3a.

Altona Lagoon (2)

Location: 17°45'N, 64°41'W; 1 km east of Christiansted, St. Croix.
Area: 100 ha.
Altitude: 0m.
Province and type: 8.41.13; 05, 07 & 08.
Site description: A tidal saline lagoon, up to 5m deep, with fringing mangrove swamps. The lagoon lies 100m inland from open sea beaches, and is connected to the sea by a narrow channel. The salinity ranges from 30-40 p.p.t.
Principal vegetation: Mangrove swamps with *Avicennia germinans* and *Rhizophora mangle.*
Land tenure: Unknown, but thought to be mainly privately owned.
Protection: Under the jurisdiction of Coastal Zone Management, U.S. Virgin Islands Government.
Land use: Fishing and harvesting of crabs.
Waterfowl: A breeding site for *Bubulcus ibis, Anas bahamensis* and *Himantopushimantopus*, and a roosting and feeding area for eight species of Ardeidae and 19 species of shorebirds, including *Steganopus tricolor.*
Other fauna: A breeding area for *Columba leucocephala* and a wintering area for many species of Parulidae. The channel connecting the lagoon with the sea is one of the major fishing and shrimping areas on St. Croix.

Threats: The channel is silting up, and the wetland is threatend by the encroachment of an existing hotel and golf course, and the proposed construction of a harbour for cruise ships.
Research and conservation: Fever has studied the formation of the lagoon, and the avifauna is well known, but little work has been conducted on the other fauna. A proposal to commence dredging of the channel is currently awaiting approval.
References: Fever (1975).
Source: Fred W. Sladen.
Criteria for inclusion: 3a.

Southgate Pond (3)

Location: 17°45'N, 64°40'W; 4 km northeast of Christiansted, St. Croix.
Area: 16 ha.
Altitude: 0m.
Province and type: 8.41.13; 05, 07 & 08.
Site description: A semi-permanent fresh to brackish pond, up to 1m deep, with mangrove swamps; 100m inland from a sea beach. The pond is fresh when first flooded at the beginning of the rainy season, and becomes brackish by the end of the dry season (salinity up to 15 p.p.t.). The pond periodically dries out during very dry years (about once every five years).
Principal vegetation: Mangrove swamps with *Avicennia germinans* and *Laguncularia racemosa.*
Land tenure: Privately owned.
Protection: Under the jurisdiction of Coastal Zone Management, U.S. Virgin Islands Government.
Land use: Recreation on adjacent beaches. There is a marina nearby.
Waterfowl: An important area for a wide variety of breeding, passage and wintering waterfowl. Breeding species include *Podilymbus podiceps, Nycticorax nycticorax, Butorides virescens, Egretta caerulea, Anas bahamensis* (up to 20 during the breeding season and 150 at other times), *Gallinula chloropus, Fulica caribaea, Charadrius wilsonius, C. vociferus, Himantopus himantopus* and *Sterna albifrons.* Non-breeding visitors include *Pelecanus occidentalis*, eight species of Ardeidae, a variety of Anatidae (including up to 250 *Anas discors*), *Porzana carolina, Fulica americana* and over 20 species of migratory shorebirds. *Rallus longirostris* formerly occurred, but is now believed to be extinct in the area.
Other fauna: A breeding site for *Columba leucocephala* and a wintering area for *Pandion haliaetus, Falco peregrinus* and *F. columbarius.* The deer *Odocoileus virginianus* occurs in the area.
Threats: The present owner proposes to dredge the pond and build an extension to an existing marina which is now immediately adjacent to it.
Research and conservation: Southgate Pond is the richest wetland on St. Croix for Anatidae, and one of the most important for Ardeidae and shorebirds. The pond and environs should be protected in a national wildlife refuge.
Source: Fred W. Sladen.
Criteria for inclusion: 2b & 3a.

Coakley Bay Pond (4)

Location: 17°46'N, 64°39'W; 5 km ENE of Christiansted, St. Croix.
Area: 7 ha.
Altitude: 0m.
Province and type: 8.41.13; 05, 07 & 08.
Site description: A semi-permanent fresh to brackish pond, up to 1m deep, with mangrove swamps; 100m inland from a sea beach. The pond fills during the rainy season and shrinks during the dry season, periodically drying out completely (about once in every five years). The salinity ranges from 0-20 p.p.t.
Principal vegetation: Mangrove swamps with *Avicennia germinans* and *Rhizophora mangle.*
Land tenure: Unknown.

Protection: Under the jurisdiction of Coastal Zone Management, U.S. Virgin Islands Government.
Land use: Fishing and harvesting of crabs. Recreation on adjacent beaches.
Waterfowl: A breeding site for *Anas bahamensis, Charadrius wilsonius, C. vociferus, Himantopus himantopus* and *Sterna albifrons*, and a feeding area for *Podilymbus podiceps, Pelecanus occidentalis*, eight species of Ardeidae, five species of Anatidae and 19 species of migratory shorebirds.
Other fauna: A breeding site for *Columba leucocephala* and a wintering area for *Pandion haliaetus.* The deer *Odocoileus virginianus* occurs in the area.
Threats: The pond is threatened by development in surrounding areas.
Source: Fred W. Sladen.
Criteria for inclusion: 3a.

Great Pond (5)

Location: 17°43'N, 64°39'W; 4 km southeast of Christiansted, St. Croix.
Area: 50 ha.
Altitude: 0m.
Province and type: 8.41.13; 05, 06, 07 & 08.
Site description: A tidal saline lagoon, up to 1m deep, with fringing mangrove swamps and mudflats; 100m inland from a sea beach. The lagoon receives run-off from a watershed of about 300 ha. The tidal rise and fall is up to 30 cm, and the salinity varies from 20-40 p.p.t.
Principal vegetation: Mangrove swamps with *Avicennia germinans, Laguncularia racemosa* and *Rhizophora mangle.*
Land tenure: Unknown.
Protection: Under the jurisdiction of Coastal Zone Management, U.S. Virgin Islands Government.
Land use: Fishing, and harvesting of crabs with nets and traps.
Waterfowl: A particularly important breeding and wintering area for *Anas bahamensis*, and a breeding site for *Nyctanassa violacea, Butorides virescens, Egretta alba, Charadrius wilsonius, Himantopus himantopus* and *Sterna albifrons.* Also an important feeding site for *Egretta caerulea, E. tricolor, E. thula* and *Ardea herodias*, and a passage and wintering area for *Anas discors* and 24 species of migratory shorebirds including *Charadrius melodus, Numenius phaeopus, Catoptrophorus semipalmatus* and *Calidris bairdii.*
Other fauna: A wintering area for *Pandion haliaetus, Circus cyaneus, Falco peregrinus* and*F. columbarius.* The lagoon supports many commercially important species of fishes and crabs.
Threats: No information.
Source: Fred W. Sladen.
Criteria for inclusion: 3a.

Cassava Garden (6)

Location: 17°42'N, 64°44'W; 4 km southwest of Christiansted, St. Croix.
Area: 15 ha.
Altitude: 0m.
Province and type: 8.41.13; 04, 05, 07, 08 & 13.
Site description: A complex of saline ponds, up to 1m deep, mangrove swamps and periodically flooded freshwater marshes behind sea beaches and low rocky cliffs. Water levels increase during the rainy season, and salinities decrease.
Principal vegetation: Mangrove swamps with *Avicennia germinans* and *Laguncularia racemosa.*
Land tenure: Under corporate ownership.
Protection: Under the jurisdiction of Coastal Zone Management, U.S. Virgin Islands Government.
Land use: Fishing and harvesting of crabs.

Waterfowl: A breeding site for *Nycticorax nycticorax, Bubulcus ibis, Butorides virescens Egretta caerulea, E. alba, Anas bahamensis, Gallinula chloropus, Charadrius wilsonius, Himantopus himantopus* and *Sterna albifrons.* Non-breeding visitors include *Pelecanus occidentalis*, nine species of Ardeidae, *Plegadis falcinellus*, seven species of Anatidae, four species of Rallidae and 23 species of migratory shorebirds (including *Charadrius melodus*).
Other fauna: A breeding site for *Phaethon lepturus* (the only site on St. Croix) and *Columba leucocephala*, and a wintering area for *Pandion haliaetus, Falco peregrinus* and *F. columbarius.* Mullet *Mugil* sp occur in the ponds.
Threats: There are plans to fill in the wetland for the construction of a refinery.
Source: Fred W. Sladen.
Criteria for inclusion: 3a.

Krause Lagoon (7)

Location: 17°42'N, 64°46'W; 7 km southwest of Christiansted, St. Croix.
Area: 200 ha.
Altitude: 0-5m.
Province and type: 8.41.13; 03, 05, 06, 07, 08 & 15.
Site description: Formerly a large tidal lagoon, up to 5m deep, with mangrove swamps, sandy beaches and intertidal mudflats. Much of the area has now been industrialized; there are large cooling ponds for sea-water used in an alumina refinery, and a deep water harbour for oil tankers visiting the nearby oil refinery.
Principal vegetation: Mangrove swamps with *Avicennia germinans, Laguncularia racemosa* and *Rhizophora mangle.*
Land tenure: Privately owned.
Protection: Under the jurisdiction of Coastal Zone Management, U.S. Virgin Islands Government.
Land use: The area includes a container port, transhipment port, alumina refinery and oil refinery.
Waterfowl: A breeding site for *Nyctanassa violacea, Bubulcus ibis, Butorides virescens, Egretta caerulea, E. thula, E. alba, Anas bahamensis, Gallinula chloropus, Charadrius wilsonius, C. vociferus, Catoptrophorus semipalmatus* (the only known breeding site in the U.S. Virgin Islands), *Himantopus himantopus* and *Sterna albifrons.* Non-breeding visitors include *Pelecanus occidentalis*, ten species of Ardeidae, *Phoenicopterus ruber, Anas crecca, A. discors, Porzana carolina*, 26 species of shorebirds and ten species of Laridae. The lagoon is the only regular locality for *Calidris canutus* in the U.S. Virgin Islands, and a variety of uncommon shorebirds have been recorded including *Limnodromus scolopaceus, Calidris bairdii* and *C. alpina.*
Other fauna: A breeding site for *Columba squamosa* and *C. leucocephala*, a feeding area for *Fregata magnificens*, and a wintering area for *Pandion haliaetus, Falco peregrinus* and *F. columbarius.* The lagoon is rich in marine fishes and crustaceans.
Threats: The lagoon has already been extensively modified. The alumina refinery is up for sale, and it is possible that the new owners may expand operations. If not, the cooling ponds will be drained.
Research and conservation: Despite the disturbance, the area remains very important for waterfowl and is the most important staging area for migratory shorebirds in the U.S. Virgin Islands. Some restoration would be possible and a part of the area could be protected as a wildlife reserve.
Source: Fred W. Sladen.
Criteria for inclusion: 2b & 3a.

Manning Bay (8)

Location: 17°42'N, 64°47'W; 8 km WSW of Christiansted, St. Croix.
Area: 10 ha.
Altitude: 0m.

Province and type: 8.41.13; 01, 03, 05, 06 & 08.
Site description: Shallow inshore waters of the open sea, with many small islands, patches of mangrove swamp, sandy beaches and intertidal mudflats; up to 3m deep and with salinities ranging from 30-40 p.p.t.
Principal vegetation: Mangrove swamps with *Avicennia germinans*, *Laguncularia racemosa*, *Conocarpus erectus*, *Rhizophora mangle* and *Hippomane mancinella.*
Land tenure: Owned by the U.S. Virgin Islands Government.
Protection: Under the jurisdiction of Coastal Zone Management, U.S. Virgin Islands Government.
Land use: Fishing and harvesting of crabs. The wetland lies close to the island's airport.
Waterfowl: A breeding area for *Nyctanassa violacea*, *Bubulcus ibis*, *Egretta caerulea*, *E. thula*, *E. alba*, *Anas bahamensis*, *Charadrius wilsonius*, *Himantopus himantopus* and possibly *Butorides virescens*; and a feeding and roosting site for *Pelecanus occidentalis*, *Ardea herodias*, and many species of migratory shorebirds and Laridae.
Other fauna: The White-crowned Pigeon *Columba leucocephala* is a resident breeding bird, and *Pandion haliaetus*, *Falco peregrinus*, *F. columbarius* and at least 12 species of Parulidae occur on passage and in winter. Hawksbill Turtles *Eretmochelys imbricata* feed in the bay and may nest on nearby beaches. The bay supports a rich marine fauna including many commercially important fishes and crustaceans.
Threats: The bay is threatened by pollution from a nearby oil refinery and an alumina refinery, and a rubbish dump is encroaching on the wetland. Potential port development also poses a threat in the bay.
Research and conservation: According to Baker, in 1980 Manning Bay contained the best example of unspoiled mangrove swamps in the the U.S. Virgin Islands outside St. John. Baker identified the bay as a priority area for protection because of its unspoiled condition, the large number of species present, and the lack of similar areas elsewhere in the islands. Baker's conclusions are still applicable in 1985. Proposals have been submitted for making this area into a Territorial Park, Wildlife Refuge or Natural Wetlands reserve.
References: Yntema (1972); Baker (1980).
Source: Fred W. Sladen.
Criteria for inclusion: 2b & 3a.

Westend Salt Pond (9)

Location: 17°41'N, 64°53'W; 3 km SSW of Frederiksted, at the southwestern tip of St. Croix.
Area: 100 ha.
Altitude: 0-1m.
Province and type: 8.41.13; 05, 07 & 08.
Site description: A saline pond, up to 2m deep, with fringing mangrove swamps and four smaller peripheral ponds; within 30m of open sea beaches. There is no surface connection with the sea and the water level is affected mainly by rainfall, but there may be some subterranean tidal influence.
Principal vegetation: Mangrove swamps with *Avicennia germinans* and *Laguncularia racemosa.* Dry cactus scrub to the east and dune vegetation to the west.
Land tenure: Three-quarters of the area is owned by the U.S. Government; the ownership of the remainder is unknown.
Protection: The area owned by the U.S. Government is included within a National Wildlife Refuge.
Land use: Recreation on the beaches.
Waterfowl: A breeding site for *Anas bahamensis*, *Charadrius wilsonius*, *Himantopus himantopus* and *Sterna albifrons*. Non-breeding visitors include *Podilymbus podiceps*, *Pelecanus occidentalis*, eight species of Ardeidae, *Anas discors*, 21 species of migratory shorebirds and 12 species of Laridae.
Other fauna: A breeding site for *Columba leucocephala* and a wintering area for *Falco peregrinus* and *F. columbarius*. The beaches are a major nesting site for Leatherback Turtles *Dermochelys coriacea.*
Threats: Pollution from domestic sewage and the dumping of rubbish from nearby residential areas. The pond has been proposed as a site for a marina and seaplane landing area.

Research and conservation: The portion of the pond not included within the National Wildlife Refuge should be managed to provide better cover and protection for wildlife.
Source: Fred W. Sladen.
Criteria for inclusion: 3a.

Perserverence Bay Pond (10)

Location: 18°22'N, 64°59'W; on the south coast of St. Thomas, 6 km west of Charlotte Amalie.
Area: 2.8 ha.
Altitude: 1-2m.
Province and type: 8.41.13; 07 & 08.
Site description: An inland mangrove swamp and brackish marshes subject to seasonal flooding and drying out.
Principal vegetation: Mangrove swamps with *Avicennia germinans, Laguncularia racemosa* and *Rhizophora mangle.*
Land tenure: No information.
Protection: Under the jurisdiction of Coastal Zone Management, U.S. Virgin Islands Government.
Land use: Some illegal hunting.
Waterfowl: *Podilymbus podiceps, Anas bahamensis* and *Gallinula chloropus* probably breed. Depending of the depth of the pond, the shallow sections often attract feeding *Himantopus himantopus* which may also breed. The wetland is used by a variety of migrants including *Anas americana, A. discors, Tringa melanoleuca, T. flavipes* and *Micropalama himantopus.*
Other fauna: No information.
Threats: Disturbance from illegal hunting.
Source: Robert L. Norton.
Criteria for inclusion: 3a.

Mangrove Lagoon and Benner Bay (11)

Location: 18°19'N, 64°52'W; on the southeast coast of St. Thomas, 7 km ESE of Charlotte Amalie.
Area: 345 ha (including 40 ha of mangroves).
Altitude: 0m.
Province and type: 8.41.13; 01, 03, 06, 07 & 08.
Site description: A shallow sea bay (Benner Bay), a saline lagoon, over 2m deep, with wide connection to the sea (Mangrove Lagoon), and several offshore cays including Bovoni, Patricia and Cas Cays; with extensive mangrove swamps, intertidal mudflats and beds of sea grasses. The mangrove swamps and beds of sea grasses have been much reduced by shoaling and pollution. Mangrove Lagoon has a salinity of about 42 p.p.t., and is subject to periodic flooding and drying out.
Principal vegetation: Beds of sea grasses, and mangrove swamps with *Avicennia germinans, Laguncularia racemosa* and *Rhizophora mangle.*
Land tenure: Privately owned.
Protection: Under the jurisdiction of Coastal Zone Management, U.S. Virgin Islands Government, but there is little real enforcement.
Land use: The wetland was little disturbed until the late 1960s, but there is now a considerable amount of development and pollution in the area, and parts of the wetland have been filled.
Waterfowl: An important area for a wide variety of breeding, passage and wintering waterfowl. Breeding species include *Nyctanassa violacea, Egretta caerulea, E. tricolor, E. thula, E. alba, Ardea herodias, Anas bahamensis, Rallus longirostris, Charadrius wilsonius, C. vociferus* and *Himantopus himantopus. Pelecanus occidentalis* is a common non-breeding visitor. Common passage migrants and winter visitors include *Anas discors, Charadrius semipalmatus, Tringa melanoleuca, T. flavipes, Actitis macularia, Arenaria interpres, Calidris pusilla, Micropalama himantopus* and *Larus atricilla.*

Other fauna: The White-crowned Pigeon *Columba leucocephala* is a resident breeder and *Pandion haliaetus, Falco peregrinus* and *Ceryle alcyon* occur on passage and in winter. The area was formerly a very important nursery ground for many species of fishes and is still important for juvenile sea turtles, Spiny Lobster *Panulirus argus* and Tarpon *Megalops atlantica.* There are some good quality patch and fringing coral reefs offshore.
Threats: The wetlands are under threat from a variety of sources, and much of the area has already been seriously degraded. The principal threats include: pollution of various kinds; filling and dredging for marina development; nutrient-rich run-off from an overloaded and malfunctioning sewage treatment plant; sewage from boats anchored in Benner Bay; the dumping of rubbish including old automobiles; and increased sedimentation as a result of erosion on nearby slopes.
Research and conservation: Norton has conducted a number of waterfowl surveys, and Raffaele has recently published a bird list for the area. Baker identified Mangrove Lagoon and Benner Bay as a priority area for protection, and the wetlands have been included in a larger area proposed as a National Marine Sanctuary. However, a cleaning up operation would be necessary to restore the seriously disturbed areas.
References: Baker (1980); Raffaele (1983).
Source: Robert L. Norton.
Criteria for inclusion: 2c & 3a.

Vessup Bay Pond (12)

Location: 18°19'N, 64°51'W; near Red Hook, at the eastern end of St. Thomas.
Area: 2.8 ha.
Altitude: 1m.
Province and type: 8.41.13; 07 & 08.
Site description: A shallow coastal pond, up to 2m deep, with mangrove fringe, subject to periodic flooding from nearby upland areas. The beach ridge separating the pond from the bay has recently been broken, allowing free flow of bay water into the pond. Salinities range from almost fresh to hypersaline (38.7 p.p.t. in October 1983).
Principal vegetation: Mangrove swamps with *Avicennia germinans* and *Rhizophora mangle.*
Land tenure: Owned by the Virgin Islands Port Authority, U.S. Virgin Islands Government.
Protection: Under the jurisdiction of Coastal Zone Management, U.S. Virgin Islands Government.
Land use: A major road runs the length of the pond, and there is a parking lot at one end.
Waterfowl: A resting and feeding area for local populations of *Podilymbus podiceps, Anas bahamensis, Gallinula chloropus* and *Himantopus himantopus.* Migrants include *Egretta caerulea, Ardea herodias, Anas discors* and *Aythya collaris.*
Other fauna: *Ceryle alcyon* occurs in winter.
Threats: There are government plans to dredge the pond and promote marina development.
Research and conservation: Some waterfowl surveys have been conducted by Norton.
Source: Robert L. Norton.
Criteria for inclusion: 3a.

Magen's Bay Wetland (13)

Location: 18°22'N, 65°55'W; 1 km north of Charlotte Amalie, St. Thomas.
Area: 3.6 ha.
Altitude: 1-2m.
Province and type: 8.41.13; 05, 07 & 08.
Site description: A brackish marsh with mangrove swamps, separated from the sea by a sand barrier and sandy beach.
Principal vegetation: Mangrove swamp with *Laguncularia racemosa* and *Rhizophora mangle.*
Land tenure: Government property (Magen's Bay Authority).
Protection: Under the jurisdiction of Coastal Zone Management, U.S. Virgin Islands Government.

Land use: Public recreation along the beach; development to the south.
Waterfowl: An important area for resident *Nyctanassa violacea, Butorides virescens* and *Gallinula chloropus*; and a wintering area for *Gallinago gallinago.*
Other fauna: A major wintering area for migrant passerines, and a roosting area for bats. There is a large colony of *Cardisoma* sp in the muddy substrate, and the eel *Anguilla anguilla* has been collected in the swamp.
Threats: Development of surrounding areas, and the possible draining of the swamp as mosquito control.
Research and conservation: Norton and colleagues have conducted annual bird censuses since 1977. The wetland is presently under the control of the Department of Conservation and Cultural Affairs (DCCA) and Coastal Zone Management, and has been designated by the DCCA as an area of concern.
Source: Robert L. Norton.
Criteria for inclusion: 3a.

Mary Point Pond (14)

Location: 18°22'N, 64°45'W; near Mary Point at the northernmost tip of St. John.
Area: 4.8 ha.
Altitude: 0-1m.
Province and type: 8.41.13; 04, 05, 07 & 08.
Site description: A slightly brackish pond, over 1m deep, with muddy shoreline, fringing mangrove swamps and brackish marshes; and nearby sandy beaches and rocky shores. The pond is subject to periodic flooding and drying out.
Principal vegetation: Red Mangroves *Rhizophora mangle*; secondary forest and scrub with many introduced species in surrounding areas.
Land tenure: Owned by the U.S. National Park Service.
Protection: Within the Virgin Islands National Park (3,644 ha of land and 2,429 ha of sea) established in 1956, and designated a Biosphere Reserve (6,127 ha) in 1976. Under the jurisdiction of the National Park Service in the Federal Government.
Land use: Outdoor recreation; there is public access to a nearby beach and residential development in neighbouring areas. Extensive plantation agriculture in the past destroyed all the native terrestrial vegetation in the area.
Waterfowl: Breeding birds include *Podilymbus podiceps, Anas bahamensis, Rallus longirostris*, a hybrid population of *Fulica americana and F. caribaea*, and *Himantopus himantopus. Pelecanus occidentalis* is a common non-breeding visitor, and several species of Ardeidae, *Anas discors* and a variety of shorebirds are common on passage and in winter.
Other fauna: *Pandion haliaetus, Falco peregrinus* and *Ceryle alcyon* occur aswinter visitors.
Threats: There is residential development in the area, and increased sedimentation as a result of nearby road improvements is causing problems. The introduced mongoose *Herpestes auropunctatus* poses a threat to breeding birds.
References: IUCN (1982); Raffaele (1983).
Source: Robert L. Norton.
Criteria for inclusion: 3a.

Other wetlands on St. John (15)

Location: 18°20'N, 64°45'W; along the south coast and around Coral Bay, St. John.
Area: Seven wetlands totalling 20.8 ha.
Altitude: 0-2m.
Province and type: 8.41.13; 07 & 08.
Site description: Seven small brackish to saline ponds with mangrove swamps: Friis Bay Pond (0.4 ha); Grootpan Bay Pond (9.9 ha); Lameshur Bay Pond (0.8 ha); Calabash Boom Pond (0.4 ha); Europa Bay Pond (6.0 ha); Fortsberg Pond (1.9 ha); and Hart Bay Pond (1.4 ha). Most are 1-2m deep; salinities range from almost fresh (Lameshur Bay and Hart Bay) to 20-30 p.p.t. (Friis Bay and Europa Bay); all are subject to seasonal fluctuations in water level.

Principal vegetation: All ponds have some mangroves, either *Avicennia germinans* or *Rhizophora mangle* or both.
Land tenure: Grootpan Bay, Lameshur Bay and Europa Bay Ponds are owned by the National Park Service; Fortsberg Pond is privately owned; the ownership of the others is unknown.
Protection: Grootpan Bay, Lameshur Bay and Europa Bay Ponds are within the Virgin Islands National Park (6,073 ha) established in 1956, and Biosphere Reserve (6,127 ha) established in 1976. The other ponds are under the jurisdiction of Coastal Zone Management, U.S. Virgin Islands Government, but there is little real enforcement.
Land use: Hunting and bird-watching at ponds in the National Park. A road runs close to Friis Bay Pond and Fortsberg Pond, and there is residential development and road construction on the slopes above Hart Bay Pond.
Waterfowl: Similar to Mary Point Pond (site 8).
Other fauna: No information.
Threats: Increased sedimentation from nearby road construction and/or housing developments is causing problems at all seven ponds, and there is some disturbance from domestic animals at Fortsberg Pond.
Research and conservation: Shorebird and duck surveys have been carried out by Norton at all ponds except Friis Bay Pond.
Source: Robert L. Norton.
Criteria for inclusion: 3a.

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APPENDIX

An Annotated Checklist of the Waterfowl of the Neotropical Realm

AN ANNOTATED CHECKLIST OF THE WATERFOWL OF THE NEOTROPICAL REALM

Based on the recent literature, information on wetlands provided for this inventory, and detailed information on waterfowl provided by the following:

Argentina: Manuel Nores and Mariano A. Gelain
Bahamas: The Bahamas National Trust (*per* Susan Holowesko)
Belize: Dora Weyer
Bermuda: David B. Wingate
Bolivia: Percy Baptista Lazarte, José Cabot, Eliana Flores, Werner Hanagarth, Marco Octavio Ribera and Brian Woods
Brazil: Paulo de Tarso Zuquim Antas and Luiz A. Pedreira Gonzaga
Cayman Islands: Patricia Bradley
Chile: Roberto P. Schlatter
Colombia: Luis G. Naranjo and Jorge Eduardo Botero
Cuba: Orlando H. Garrido
Dominican Republic: Josefa Esperanza Alvarez, Julio Cicero, Rosa Angélica Espinal, Mario E. Feliz de Cedeño, Nelson García, Altagracia Gómez, Manuel González, Julia Matilda Mota, Miguel Silva, Domingo A. Siri, Annabelle Stockton de Dod and Tomás A. Vargas
Ecuador: Paul Greenfield, Felix Man-ging, Fernando Ortíz Crespo and Clemencia Vela
French Antilles: Edouard Benito-Espinal
French Guiana: Jean-Luc Dujardin and Jean-Marc Thiollay
Guatemala: Rubén Velásquez and Luis Villar Anleu
Jamaica: Patrick W. Fairbairn, John Fletcher and Robert L. Sutton
Mexico: Antonio C. Rogel Bahena
Netherlands Antilles: Bart A. de Boer
Paraguay: Nancy E. Lopéz
Puerto Rico: José Luis Chabert and José A. Colon
Suriname: Ben H.J. de Jong and Arie L. Spaans
Trinidad and Tobago: Molly Gaskin, Geddes Hislop, Carol James, Nadra Nathai-Gyan and Eugene K. Ramcharan
U.S. Virgin Islands: Robert L. Norton and Fred Sladen
Uruguay: Eduin Palerm
Venezuela: David Gerardo Cordero, Benjamín Busto, Arelis Chang, Miguel Lentino, Norma Márquez, Cristina Ramo, Andrés Eloy Seijas and Betsy Trent Thomas.

The sequence and scientific nomenclature follow Blake, E.R. 1977, Manual of Neotropical Birds, Volume 1, except that the family Rynchopidae and the tern genera *Chlidonias*, *Phaetusa*, *Gelochelidon*, and *Hydroprogne* have been retained.

Gaviidae

Gavia stellata Red-throated Loon: Extralimital; scarce winter visitor from the Nearctic to the Pacific coast of Mexico.
Gavia pacifica Pacific Loon: Mainly extralimital; winter visitor from the Nearctic to the Pacific coast of Mexico.
Gavia immer Common Loon: Extralimital; scarce winter visitor from the Nearctic to the Pacific coast of Mexico.

Podicipedidae

Podilymbus podiceps Pied-billed Grebe: Common almost throughout the region.
Podilymbus gigas Atitlan Grebe: Endemic to Lake Atitlan, Guatemala; endangered; the population has decreased from an estimated 240 birds in 1975 to only 45 in 1984. Listed in the 1981 edition of the ICBP Bird Red Data Book as endangered.

Rollandia rolland White-tufted Grebe: Endemic to South America; widespread and common in the south, extending north to central Peru and southern Brazil.

Rollandia micropterum Short-winged Grebe: Endemic to South America; common within its restricted distribution in the Andes of southern Peru and Bolivia.

Podiceps major Great Grebe: Endemic to South America; widespread and fairly common in the south, extending north to southern Peru and southern Brazil.

Podiceps dominicus Least Grebe: Widespread and locally common throughout tropical regions.

Podiceps grisegena Red-necked Grebe: Extralimital; scarce winter visitor from the Nearctic to Mexico.

Podiceps auritus Horned Grebe: Extralimital; scarce winter visitor from the Nearctic to Mexico and Bermuda.

Podiceps nigricollis Eared Grebe: Mainly extralimital; winter visitor from the Nearctic to Mexico and Guatemala, breeding in northwestern Mexico.

Podiceps (nigricollis) andinus Colombian Grebe: Endemic to the Andes of Colombia (Lake Tota and the Bogota Savanna); last reported in 1977 and now almost certainly extinct. Listed in the 1981 edition of the ICBP Bird Red Data Book as endangered.

Podiceps occipitalis Silvery Grebe: Endemic to South America; widespread and common in southern Chile, south and central Argentina and the Andes north to southern Colombia (where scarce).

Podiceps taczanowskii Puna Grebe: Endemic to Lake Junin, Peru; endangered; in 1979, the total population was estimated at 300 birds, but numbers may have decreased since then. Two pairs were translocated to the nearby Laguna Chacaycancha in February 1985. Listed in the 1981 edition of the ICBP Bird Red Data Book as rare.

Podiceps gallardoi Hooded Grebe: Endemic to southern Argentina; locally common within its restricted distribution in Patagonia; the total population is currently estimated at 3,000-3,500 birds. Listed in the 1981 edition of the ICBP Bird Red Data Book as rare.

Aechmophorus occidentalis Western Grebe: Mainly extralimital; winter visitor from the Nearctic to Mexico; a local breeding bird in the highlands of northern Mexico.

Pelecanidae

Pelecanus erythrorhynchos American White Pelican: Mainly extralimital; winter visitor from the Nearctic to Mexico, breeding in northeastern Mexico; vagrant to Central America and the Caribbean. The West Coast population wintering in western Mexico is estimated at about 16,000 birds.

Pelecanus occidentalis Brown Pelican: Widespread and common in Mexico, Central America, the Bahamas and the Greater Antilles; a very local breeding bird on the coasts of Ecuador, Colombia and Venezuela, wandering south to central Peru and east to the Amazon Delta. The Peruvian Pelican *P. (o.) murphyi* is an abundant sea-bird of coastal Peru and Chile.

Phalacrocoracidae

Phalacrocorax auritus Double-crested Cormorant: Mainly extralimital; resident and winter visitor from the Nearctic in Mexico and the northern Caribbean; uncommon visitor and possible breeding bird in Belize.

Phalacrocorax olivaceus Neotropic Cormorant: Common almost throughout the region.

Anhingidae

Anhinga anhinga Anhinga: Widespread and common in tropical regions of Mexico, Central America and South America south to Peru, northern Argentina and Uruguay; also resident in Cuba, but a straggler elsewhere in the Caribbean.

Ardeidae

Botaurus lentiginosus American Bittern: Mainly extralimital; uncommon winter visitor from the Nearctic to Mexico, Central America, Bermuda and the northern Caribbean.

Botaurus pinnatus Pinnated Bittern: Endemic to Neotropical Realm; generally rather scarce and local in eastern Mexico, Central America and northwestern Colombia; widespread and fairly common east of the Andes south to north-central Argentina.

Ixobrychus exilis Least Bittern: Widespread and fairly common from Mexico and the Caribbean south to southern Peru and northern Argentina. The very local *I. e. bogotensis* of the Colombian Andes is fairly common at Lake Tota and wetlands on the Bogota Savanna.

Ixobrychus involucris Stripe-backed Bittern: Endemic to South America; widely distributed but rather scarce from northern Colombia east of the Andes to central Argentina, and west of the Andes in central Chile.

Tigrisoma lineatum Rufescent Tiger-Heron: Endemic to Neotropical Realm; widespread and fairly common in Central America from Guatemala to Panama, and in South America east of the Andes south to northern Argentina; uncommon and local west of the Andes south to Ecuador.

Tigrisoma fasciatum Fasciated Tiger-Heron: Endemic to Neotropical Realm; widely distributed but rather scarce in eastern Central America and western South America from northern Venezuela south to northwestern Argentina (Jujuy and Salta). The nominate subspecies, confined to southeastern Brazil and northeastern Argentina (Misiones), is extremely rare; it has not been recorded in Brazil since the 1950s and is now probably extinct over most of its range. This subspecies is listed in the 1981 edition of the ICBP Bird Red Data Book as indeterminate.

Tigrisoma mexicanum Bare-throated Tiger-Heron: Endemic to Neotropical Realm; widespread and fairly common in Mexico, Central America and northwestern Colombia.

Zebrilus undulatus Zigzag Heron: Endemic to South America; widely distributed in the Amazon and Orinoco basins, but apparently very scarce everywhere.

Nycticorax nycticorax Black-crowned Night-Heron: Common almost throughout the region.

Nyctanassa violacea Yellow-crowned Night-Heron: Widespread and fairly common in Mexico, Central America, the Caribbean and coastal South America south to northern Peru and southeastern Brazil. The subspecies endemic to Bermuda became extinct in the early 17th century, but the species was successfully re-introduced in the late 1970s.

Pilherodius pileatus Capped Heron: Endemic to Neotropical Realm; widespread and fairly common in tropical regions east of the Andes and in northern Colombia; uncommon in eastern Panama.

Syrigma sibilatrix Whistling Heron: Endemic to South America; widespread and fairly common in the llanos of Colombia and Venezuela, and from Bolivia to central Argentina.

Cochlearius cochlearius Boat-billed Heron: Endemic to Neotropical Realm; widespread and fairly common in tropical regions.

Bubulcus ibis Cattle Egret: Common almost throughout the region.

Butorides virescens Green Heron: Widespread and common resident in Mexico, Central America and the Caribbean, and local resident in northern Venezuela; common winter visitor from the Nearctic south to Colombia and Venezuela.

Butorides striatus Striated Heron: Widespread and common almost throughout South America and in central and eastern Panama.

Butorides sundevalli Lava Heron: Endemic to the Galapagos Islands, where common.

Egretta caerulea Little Blue Heron: widespread and common in Mexico, Central America and the Caribbean; widespread and locally common, particularly in coastal regions, in South America south to southern Peru and Uruguay; occasional in northern Chile.

Egretta tricolor Tricolored Heron: Widespread and common in coastal regions of Mexico, Central America, the Caribbean and South America south to southern Peru and northeastern Brazil.

Egretta rufescens Reddish Egret: Widely distributed but very scarce along the coasts of Mexico, Central America, the northern Caribbean and northern Colombia and Venezuela. Vulnerable; the entire population (including North American birds) is thought to number only 3,000-5,000 pairs.

Egretta thula Snowy Egret: Common almost throughout the region.

Egretta gularis Western Reef Heron: Extralimital; vagrant from the Old World, recently recorded in Saint Lucia and Barbados.

Egretta garzetta Little Egret: Extralimital; vagrant from the Old World.

Egretta alba Great Egret: Common almost throughout the region.

Ardea cinerea Grey Heron: Extralimital; vagrant from the Old World.

Ardea herodias Great Blue Heron: Common breeding bird and winter visitor in Mexico and the northern Caribbean; common winter visitor and local breeder in Central America; winter visitor in small numbers to the southern Caribbean and extreme northwestern South America. The subspecies endemic to the Galapagos Islands is fairly common.

Ardea cocoi White-necked Heron: Endemic to Neotropical Realm; scarce resident in eastern Panama; widespread and fairly common almost throughout lowland South America.

Agamia agami Chestnut-bellied Heron: Endemic to Neotropical Realm; widely distributed but very scarce in humid tropical lowlands of Mexico, Central America, northwestern Colombia, and the basins of the Orinoco and Amazon.

Ciconiidae

Mycteria americana Wood Stork: Widespread and common in Mexico and Central America, and in South America north and east of the Andes to central Argentina; rather scarce and local in the northern Caribbean; vagrant to coastal Peru and Chile.

Euxenura maguari Maguari Stork: Endemic to South America; widespread and fairly common east of the Andes from eastern Colombia to central Argentina; occasional visitor to central and southern Chile.

Jabiru mycteria Jabiru: Endemic to Neotropical Realm; very scarce in the Caribbean lowlands of Mexico, Central America and northern Colombia; widespread and locally fairly common in South America east of the Andes south to Uruguay and northern Argentina. The Mexican and Central American population is estimated at less than 150 birds.

Threskiornithidae

Harpiprion caerulescens Plumbeous Ibis: Endemic to South America; fairly common within its limited distribution from eastern Bolivia and southwestern Brazil to northern Argentina and Uruguay.

Theristicus caudatus Buff-necked Ibis: Endemic to South America; widespread and fairly common east of the Andes south to northern Argentina and Uruguay.

Theristicus (caudatus) branickii Branicki's Ibis: Endemic to South America; widely distributed but rather scarce in the Andes from Ecuador to northern Chile.

Theristicus (caudatus) melanopis Black-faced Ibis: Endemic to South America; widespread and fairly common in the lowlands of Chile and Argentina; very scarce in the coastal lowlands of southern Peru.

Cercibis oxycerca Sharp-tailed Ibis: Endemic to South America; fairly common within its limited distribution in the llanos of eastern Colombia, Venezuela and northwestern Brazil.

Mesembrinibis cayennensis Green Ibis: Endemic to Neotropical Realm; widely distributed but generally rather scarce in eastern Central America and tropical South America east of the Andes.

Phimosus infuscatus Bare-faced Ibis: Endemic to South America; widespread and fairly common east of the Andes from northern Colombia to north-central Argentina.

Eudocimus albus White Ibis: Widespread and common in Mexico, Central America, the northern Caribbean and northwestern South America south to northern Peru and east to western Venezuela. Declining in parts of Central America and the Caribbean.

Eudocimus ruber Scarlet Ibis: Endemic to South America; widely distributed but rather scarce in coastal regions from northern Colombia to eastern Brazil; common in the llanos of eastern Colombia and Venezuela. Coastal populations are declining; the range of the species is contracting in the east, and there has been no breeding in Trinidad for over ten years. The total population is now probably less than 100,000 pairs.

Plegadis chihi White-faced Ibis: A local breeding bird in Mexico, straggler in winter to Central America, and vagrant to northern Colombia and Venezuela; widespread and locally abundant from eastern Bolivia and southern Brazil to central Argentina and central Chile.

Plegadis falcinellus Glossy Ibis: Locally fairly common in eastern Central America, the northern Caribbean, northern Colombia and Venezuela.

Plegadis ridgwayi Puna Ibis: Endemic to South America; common within its limited distribution in the Andes of central and southern Peu, Bolivia and northern Chile.

Ajaia ajaja Roseate Spoonbill: Widespread and fairly common in Mexico, Central America, the northern Caribbean, and South America west of the Andes south to northern Peru and east of the Andes south to central Argentina; vagrant to Chile.

Phoenicopteridae

Phoenicopterus ruber Greater (Caribbean) Flamingo: The subspecies *P. r. ruber* is endemic tothe Neotropical Realm, occurring in four discrete populations: (1) Galapagos Islands; 400-500 birds, breeding at several localities. (2) Netherlands Antilles and the north coast of South America from northeastern Colombia to northern Brazil; at least 16,000 birds, breeding on Bonaire in the Netherlands Antilles; formerly occurred east to northeastern Brazil and probably bred in Amapa, northern Brazil, in 1971, but becoming increasingly rare in that country. (3) Yucatan Peninsula, Mexico; at least 26,000 birds, breeding at Rio Lagartos; vagrant to Belize. (4) Bahamas, Cuba and Hispaniola; unknown but 40,000-50,000 have been present at the breeding colony on Great Inagua Island in the Bahamas in recent years, and 45,000 were recorded at Bãhia de Nuevitas, Cuba, in 1983. A common visitor to many other localities in the Bahamas and Cuba, and also on Hispaniola where it occasionally breeds (Lago Enriquillo and Laguna Salada in the Dominican Republic).

Phoenicopterus chilensis Chilean Flamingo: Endemic to South America; widespread and locally very common from the Andes of Central Peru south to Tierra del Fuego, occurring in winter to Paraguay and southeastern Brazil; occasional in small numbers in southwestern Ecuador. The total population is estimated at about 500,000 birds.

Phoenicoparrus andinus Andean Flamingo: Endemic to South America; locally fairly common within its limited distribution in the high Andes of Bolivia, northwestern Argentina, northern Chile and extreme southern Peru. Very few breeding localities are known, and the total population is probably well below 50,000 birds.

Phoenicoparrus jamesi James' Flamingo: Endemic to South America; fairly common within its limited distribution in the high Andes of Bolivia, northwestern Argentina, northern Chile and southern Peru. The total population is estimated at 50,000 birds.

Anhimidae

Anhima cornuta Horned Screamer: Endemic to South America; widely distributed but rather scarce in humid tropical lowlands east of the Andes from northern Columbia to Bolivia and south-central Brazil. There are small isolated populations in the Cauca Valley in western Colombia and in southwestern Ecuador. The species became extinct in Trinidad early this century.

Chauna chavaria Northern Screamer: Endemic to South America; common within its very limited distribution in northern Colombia and western Venezuela.

Chauna torquata Southern Screamer: Endemic to South America; widespread and common in eastern Bolivia, southwestern and southern Brazil, Paraguay, Uruguay, and north and central Argentina.

Anatidae

Dendrocygna bicolor Fulvous Tree-Duck: Widely distributed but generally rather scarce from Mexico and the northern Caribbean south to eastern Peru, eastern Bolivia and northern Argentina. Vagrant to Chile.

Dendrocygna viduata White-faced Tree-Duck: Widespread and common in South America east of the Andes south to Uruguay and northern Argentina, and west of the Andes south to northern Peru; also in the lowlands of eastern Central America.

Dendrocygna arborea West Indian Tree-Duck: Endemic to the Caribbean; formerly widely distributed but now extinct in many parts of its range and decreasing almost everywhere. The Cayman Islands now hold one of the largest populations, with over 400 birds. Listed in the 1981 edition of the ICBP Bird Red Data Book as vulnerable.

Dendrocygna autumnalis Black-bellied Tree-Duck: Widespread and common in the lowlands of Mexico, Central America and South America south to northern Argentina.

Coscoroba coscoroba Coscoroba Swan: Endemic to South America; widespread and locally fairly common in southern South America, extending north to central Chile and southeastern Brazil, but decreasing in some areas.

Cygnus melancoryphus Black-necked Swan: Endemic to South America; widespread and fairly common in southern South America and the Falkland Islands, extending north to central Chile, Paraguay and southeastern Brazil.

Cygnus columbianus Whistling Swan: Extralimital; very scarce winter visitor from the Nearctic to northern Mexico; vagrant to Bermuda and the Caribbean.

Anser albifrons White-fronted Goose: Mainly extralimital; winter visitor from the Nearctic to Mexico (south to Michoacan). An average of 53,600 was recorded in Mexico in the January counts of 1978-1982.

Anser caerulescens Snow Goose: Mainly extralimital; winter visitor from the Nearctic to Mexico (south to Veracruz), and vagrant to Bermuda and the Caribbean. An average of 88,800 was recorded in Mexico in the January counts of 1978-1982.

Anser rossii Ross' Goose: Extralimital; very scarce winter visitor from the Nearctic to northern Mexico.

Branta canadensis Canada Goose: Mainly extralimital; scarce winter visitor from the Nearctic to northern Mexico; vagrant to Bermuda and the Caribbean. An average of 5,600 was recorded in Mexico in the January counts of 1978-1982.

Branta bernicla Brant (Brent) Goose: Common winter visitor from the Nearctic to the Pacific coast of northwestern Mexico (south to Sinaloa). An average of 139,000 was recorded in Mexico in the January counts of 1978-1982, almost the entire Pacific flyway population.

Chloephaga melanoptera Andean Goose: Endemic to South America; widespread and common in the Andes from central Peru to central Chile and Argentina.

Chloephaga poliocephala Ashy-headed Goose: Endemic to South America; fairly common within its limited distribution in southern Chile, Argentina and the Falkland Islands; occurs north in winter to Buenos Aires Province.

Chloephaga rubidiceps Ruddy-headed Goose: Endemic to South America; very rare and endangered in the extreme south of Chile and Argentina; still fairly common in the Falkland Islands. Formerly occurred north in winter to Buenos Aires Province. Listed in the 1981 edition of the ICBP Bird Red Data Book as vulnerable.

Chloephaga picta Upland Goose: Endemic to South America; very common within its limited distribution in southern Chile, Argentina and the Falkland Islands; occurs north in winter to Buenos Aires Province and occasionally Uruguay.

Chloephaga hybrida Kelp Goose: Endemic to South America; common within its limited distribution on the coasts of southern Chile, southern Argentina and the Falkland Islands.

Neochen jubata Orinoco Goose: Endemic to South America; widely distributed in the basins of the Orinoco and Amazon from the llanos of eastern Colombia and Venezuela to eastern Bolivia and central Brazil, and also in western Paraguay and extreme northern Argentina, but now very scarce over much of its range. The species is particularly sensitive to hunting pressure and now remains common only in remote areas (e.g. in parts of eastern Bolivia) or where given adequate protection (e.g. in parts of the llanos of Venezuela).

Lophonetta specularioides Crested Duck: Endemic to South America; widespread and common in the Andes from central Peru southwards, in coastal regions of southern Argentina and Chile, and in the Falkland Islands.

Tachyeres pteneres Flightless Steamer-Duck: Endemic to South America; common within its limited distribution in southern Argentina and Chile.

Tachyeres leucocephalus White-headed Flightless Steamer-Duck: Endemic to southern Argentina, with a very restricted distribution in coastal Chubut Province; possibly vulnerable.

Tachyeres brachypterus Falkland Islands Flightless Steamer-Duck: Endemic to the Falkland Islands, where common.

Tachyeres patachonicus Flying Steamer-Duck: Endemic to South America; fairly common within its limited distribution in southern Chile, southern Argentina and the Falkland Islands.

Anas platyrhynchos Mallard: Mainly extralimital; scarce winter visitor from the Nearctic to northern Mexico; vagrant to Central America and the Caribbean. An average of 4,900 was recorded in Mexico in the January counts of 1978-1982. There are feral breeding populations on Bermuda (introduced in 1960) and the Cayman Islands (introduced in 1983).

Anas (platyrhynchos) wyvilliana Hawaiian Duck: Extralimital; vagrant from Hawaii to Mexico.

Anas (platyrhynchos) fulvigula Mottled Duck: Mainly extralimital; resident in northeastern Mexico. An average of 3,900 was recorded in Mexico in the January counts of 1978-1982.

Anas (platyrhynchos) diazi Mexican Duck: Endemic to Mexico and adjacent U.S.A.; locally common, the total population is estimated at 55,500 birds.

Anas rubripes Black Duck: Extralimital; scarce winter visitor from the Nearctic to Bermuda.

Anas specularis Spectacled Duck: Endemic to South America; fairly common within its limited distribution in the Andes of central and southern Chile and Argentina; occasional in winter in the lowlands of Argentina east to Buenos Aires Province.

Anas flavirostris Speckled Teal: Endemic to South America; widespread and common in the south, extending north in the lowlands to central Chile, Paraguay and southeastern Brazil, and in the Andes to Venezuela.

Anas crecca Green-winged Teal: Common winter visitor from the Nearctic to Mexico, Central America and the northern Caribbean; occasionally south to Colombia. An average of 368,000 was recorded in Mexico in the January counts of 1978-1982.

Anas strepera Gadwall: Common winter visitor from the Nearctic to Mexico and Guatemala. An average of 86,000 was recorded in Mexico in the January counts of 1978-1982.

Anas americana American Wigeon: Common winter visitor from the Nearctic to Mexico, Central America, the Caribbean, northern Colombia, Trinidad and occasionally Venezuela. An average of 313,000 was recorded in Mexico in the January counts of 1978-1982.

Anas penelope European Wigeon: Extralimital; vagrant from the Old World.

Anas sibilatrix Chiloe Wigeon: Endemic to South America; widespread and common in the south, occurring north in winter to central Chile, northern Argentina, Paraguay and southeastern Brazil.

Anas bahamensis White-cheeked Pintail: Endemic to Neotropical Realm; widely distributed and locally common in the Caribbean and mainly coastal regions of South America south to southern Chile and central Argentina. Also in the Galapagos Islands.

Anas georgica Yellow-billed Pintail: Endemic to South America and nearby subantarctic islands; widespread and common throughout the south, extending north in the lowlands to southern Peru, Paraguay and southeastern Brazil, and in the Andes to Ecuador. The subspecies endemic to the Andes of Colombia *A. g. niceforoi* is now extinct.

Anas acuta Northern Pintail: Common winter visitor from the Nearctic to Mexico, Central America, the Caribbean and northern Colombia. An average of 954,000 was recorded in Mexico in the January counts of 1978-1982.

Anas versicolor Silver Teal: Endemic to South America; widespread and common in the south, extending north in the lowlands to southeastern Bolivia, Paraguay and southeastern Brazil.

Anas puna Puna Teal: Endemic to South America; common within its limited distribution in the Andes from central Peru to northern Chile and northwestern Argentina.

Anas querquedula Garganey: Extralimital; vagrant from the Old World.

Anas discors Blue-winged Teal: Common winter visitor from the Nearctic to Mexico, Central America, the Caribbean and South America south to Peru and northeastern Brazil; regular in small numbers in the Galapagos Islands. A vagrant to Chile, southeastern Brazil, Uruguay and Argentina. An average of about 550,000 was recorded in Mexico in the January counts of 1978-1982.

Anas cyanoptera Cinnamon Teal: Common resident and winter visitor in Mexico, and common winter visitor in Central America; resident (two endemic subspecies) and occasional winter visitor in Colombia and Venezuela; common and widespread in the Andes from central Peru southwards, and in southern Chile and most of Argentina.

Anas clypeata Northern Shoveler: Common winter visitor from the Nearctic to Mexico, Central America, the Caribbean and northern Colombia; occasional in Trinidad. An average of 368,000 was recorded in Mexico in the January counts of 1978-1982.

Anas platalea Red Shoveler: Endemic to South America; widespread and fairly common in the south, extending north to central Chile, Bolivia and southeastern Brazil; occasional in southern Peru.

Anas leucophrys Ringed Teal: Endemic to South America; fairly common within its limited distribution in eastern Bolivia, southern Brazil, Paraguay, northern Argentina and Uruguay.

Aix sponsa Wood Duck: Mainly extralimital; resident in Cuba; scarce winter visitor from the Nearctic to Mexico and Bermuda; occasional winter visitor to the Cayman Islands.

Merganetta armata Torrent Duck: Endemic to South America; widespread and fairly common in the Andes from Venezuela and Colombia to Tierra del Fuego.

Netta peposaca Rosy-billed Pochard: Endemic to South America; widespread and common from south-central Chile and central Argentina north to southern Paraguay and southeastern Brazil.

Netta erythrophthalma Southern Pochard: The nominate subspecies is endemic to South America; widely distributed from Colombia and Venezuela to Peru, northern Argentina and southeastern Brazil, but very local and scarce. In recent years, the species has been reported most frequently in eastern Brazil (Ceara, Rio Grande do Norte, Alagoas, Bahia, Rio de Janeiro and Distrito Federal). Listed in the 1981 edition of the ICBP Bird Red Data Book as indeterminate.

Aythya americana Redhead: Common winter visitor from the Nearctic to Mexico; vagrant to Guatemala and the Caribbean. An average of 296,000 was recorded in Mexico in the January counts of 1978-1982.

Aythya collaris Ring-necked Duck: Mainly extralimital; winter visitor from the Nearctic to Mexico, Central America and the northern Caribbean; vagrant to Trinidad and Venezuela. An average of 23,100 was recorded in Mexico in the January counts of 1978-1982.

Aythya valisineria Canvasback: Mainly extralimital; winter visitor from the Nearctic to northern and central Mexico; vagrant to Guatemala and the Caribbean. An average of 39,900 was recorded in Mexico in the January counts of 1978-1982.

Aythya marila Greater Scaup: Extralimital; scarce winter visitor from the Nearctic to northwestern Mexico and Bermuda.

Aythya affinis Lesser Scaup: Common winter visitor from the Nearctic to Mexico, Central America, the Caribbean and northern Colombia; occasional winter visitor to Ecuador, Venezuela and Trinidad. An average of 237,000 was recorded in Mexico in the January counts of 1978-1982.

Amazonetta brasiliensis Brazilian Duck: Endemic to South America; widespread and common east of the Andes from the llanos of Colombia and Venezuela to northern Argentina and Uruguay.

Sarkidiornis melanotos Comb Duck: Widely distributed but rather scarce from eastern Panama west of the Andes to northern Peru, and east of the Andes to northern Argentina and Uruguay.

Cairina moschata Muscovy Duck: Endemic to Neotropical Realm; widespread and fairly common in tropical regions of Mexico, Central America and South America west of the Andes south to Ecuador, and east of the Andes south to northern Argentina and Uruguay.

Clangula hyemalis Long-tailed Duck: Extralimital; vagrant from the Nearctic to Bermuda.

Melanitta nigra Black Scoter: Extralimital; scarce winter visitor from the Nearctic to northwestern Mexico.

Melanitta perspicillata Surf Scoter: Mainly extralimital; winter visitor from the Nearctic to northwestern Mexico; occasional winter visitor to Bermuda.

Melanitta (fusca) deglandi White-winged Scoter: Extralimital; scarce winter visitor from the Nearctic to northwestern Mexico.

Bucephala albeola Bufflehead: Mainly extralimital; scarce winter visitor from the Nearctic to northern Mexico and Bermuda. An average of 2,700 was recorded in Mexico in the January counts of 1978-1982.

Bucephala clangula Common Goldeneye: Mainly extralimital; scarce winter visitor from the Nearctic to northern Mexico and Bermuda. An average of 390 was recorded in Mexico in the January counts of 1978-1982.

Mergus cucullatus Hooded Merganser: Extralimital; very scarce winter visitor from the Nearctic to northern Mexico and Bermuda; vagrant to the Caribbean.

Mergus octosetaceus Brazilian Merganser: Endemic to South America; endangered; very rare and local in south-central Brazil, (headwaters of the Rio Sao Francisco in Minas Gerais, headwaters of the Tocantins in Goias, headwaters of the Sucuriu in Mato Grosso do Sul, and southwestern Parana), eastern Paraguay (Rio Carapa), and extreme northeastern Argentina (Misiones). Listed in the 1981 edition of the ICBP Bird Red Data Book as indeterminate.

Mergus serrator Red-breasted Merganser: Mainly extralimital; winter visitor from the Nearctic to northwestern Mexico and Bermuda; vagrant to the northern Caribbean. An average of 8,000 was recorded in Mexico in the January counts of 1978-1982.

Mergus merganser Goosander: Extralimital; very scarce winter visitor from the Nearctic to northern Mexico.

Oxyura jamaicensis Ruddy Duck: The nominate subspecies breeds in northern Mexico and is a fairly common resident in the Caribbean; also a common winter visitor from the Nearctic to Mexico (up to 105,000 counted in recent years) and Guatemala. *O. j. andina* is confined to the Andes of northern and central Colombia, where it is scarce and local; *O. j. ferruginea* is common in the Andes from southern Colombia (Nariño) to Tierra del Fuego.

Oxyura vittata Lake Duck: Endemic to South America; widespread and fairly common in Argentina and central Chile, occurring north in winter to southeastern Brazil and Paraguay.

Oxyura dominica Masked Duck: Endemic to Neotropical Realm; widely distributed but rather scarce in lowland Mexico, Central America, the Caribbean, and tropical South America west of the Andes south to northern Peru and east of the Andes south to northern Argentina and Uruguay.

Heteronetta atricapilla Black-headed Duck: Endemic to South America; fairly common within its limited distribution from southeastern Brazil and Paraguay to central Argentina and central Chile.

Opisthocomidae

Opisthocomus hoazin Hoatzin: Endemic to South America; widespread and common in the basins of the Orinoco and Amazon.

Gruidae

Grus canadensis Sandhill Crane: Mainly extralimital; winter visitor from the Nearctic to northern Mexico (up to 20,000 recorded in recent mid-winter censuses). There is a small resident population in Cuba belonging to the endemic subspecies *G. c. nesiotes*; the total population of this subspecies is estimated at 100-150 birds. *G. c. nesiotes* is listed in the 1981 edition of the ICBP Bird Red Data Book as rare.
Grus americana Whooping Crane: Extralimital; formerly a vagrant from the Nearctic to northern Mexico.

Aramidae

Aramus guarauna Limpkin: Endemic to Neotropical Realm (including Florida, U.S.A.); rather scarce and local in the Caribbean (Cuba, Jamaica and Hispaniola); generally common and widespread in tropical regions of Mexico, Central America and South America west of the Andes south to Ecuador and east of the Andes south to Uruguay and northern Argentina.

Rallidae

Rallus sanguinolentus Plumbeous Rail: Endemic to South America; widespread and common in the lowlands and Andes from central Peru and southern Brazil to southern Argentina and southern Chile.
Rallus nigricans Blackish Rail: Endemic to South America; widespread and fairly common in central and southern Brazil and Paraguay; also occurs locally in Colombia, western Venezuela, Ecuador and Peru.
Rallus longirostris Clapper Rail: Locally common in coastal areas from Mexico and the Caribbean south to northern Peru and southeastern Brazil.
Rallus (longirostris) elegans King Rail: Mainly extralimital; the subspecies endemic to Cuba (*R. l/e. ramsdeni*) is locally fairly common. The species has been recorded in Jamaica in winter.
Rallus wetmorei Plain-flanked Rail: Endemic to coastal northwestern Venezuela (Falcon, Carabobo and Aragua); status unknown.
Rallus limicola Virginia Rail: Fairly common resident in Mexico and scarce winter visitor to Guatemala and Bermuda; fairly common resident in western South America from southwestern Colombia to central Peru.
Rallus (limicola) antarcticus Austral Rail: Endemic to South America; confined to southern Argentina and southern and central Chile, where very scarce; not reported in Argentina since 1950.
Rallus semiplumbeus Bogota Rail: Endemic to the Andes of Colombia (Lake Tota and the Bogota Savanna); very scarce and local. Listed in the 1981 edition of the ICBP Bird Red Data Book as vulnerable.
Rallus maculatus Spotted Rail: Endemic to Neotropical Realm; widely distributed but scarce from Mexico and Cuba south to northern Argentina.
Amaurolimnas concolor Uniform Crake: Endemic to Neotropical Realm; widely distributed but rather scarce in humid tropical regions of southern Mexico, Central America and South America south to southeastern Brazil.
Cyanolimnas cerverai Zapata Rail: Endemic to Zapata Swamp, Cuba; very scarce. Listed in the 1981 edition of the ICBP Bird Red Data Book as rare.
Aramides mangle Little Wood-Rail: Endemic to eastern Brazil (Maranhao to Rio de Janeiro); status unknown.

Aramides axillaris Rufous-necked Wood-Rail: Endemic to Neotropical Realm; scarce resident along the Pacific coast of western Mexico, on the Caribbean coast of Yucatan and Central America, and in coastal regions of northern South America south to Ecuador and east to Suriname.

Aramides cajanea Grey-necked Wood-Rail: Endemic to Neotropical Realm; widespread and common in central and southern Mexico, Central America and South America east of the Andes south to north-central Argentina.

Aramides wolfi Brown Wood-Rail: Endemic to South America; scarce and local in the Pacific lowlands of western Colombia and Ecuador.

Aramides ypecaha Giant Wood-Rail: Endemic to South America; widespread and common from central Brazil south to north-central Argentina.

Aramides saracura Slaty-breasted Wood-Rail: Endemic to South America; common within its limited distribution in southeastern Brazil, eastern Paraguay and extreme northeastern Argentina (Misiones).

Aramides calopterus Red-winged Wood-Rail: Endemic to South America; scarce and local in eastern Ecuador, eastern Peru and adjacent western Brazil.

Anurolimnas castaneiceps Chestnut-headed Crake: Endemic to South America; scarce and local in southern Colombia, eastern Ecuador and eastern Peru.

Porzana porzana Spotted Crake: Extralimital; vagrant from the Old World.

Porzana carolina Sora Rail: Common winter visitor from the Nearctic to Mexico, Central America, the Caribbean and northern South America south to Peru and east to Guyana.

Porzana albicollis Ash-throated Crake: Endemic to South America; widespread and locally common from northern Colombia east of the Andes south to north-central Argentina.

Porzana flaviventer Yellow-breasted Crake: Endemic to Neotropical Realm; widely distributed and locally fairly common in Central America west to southern Guatemala, in the Greater Antilles, and in South America east of the Andes south to north-central Argentina.

Laterallus spilopterus Dot-winged Crake: Endemic to South America; confined to central Argentina and southern Uruguay where apparently rather scarce.

Laterallus jamaicensis Black Crake: Scarce and local resident in northwestern Mexico; scarce winter visitor to Mexico, Central America and the Greater Antilles, where it may breed (e.g. in Jamaica). Scarce and local resident in coastal Peru, Lake Junin, Peru (endemic subspecies), north and central Chile, and west-central Argentina.

Laterallus exilis Grey-breasted Crake: Endemic to Neotropical Realm; widespread and locally fairly common in Central America from Belize eastwards, and in South America south to northwestern Ecuador and the Amazon basin.

Laterallus xenopterus Rufous-faced Crake: Endemic to South America; until recently known only from one specimen taken in southeastern Paraguay, but in recent years found elsewhere in eastern Paraguay and in south-central Brazil.

Laterallus albigularis White-throated Crake: Endemic to Neotropical Realm; common within its limited distribution in eastern Central America, western Colombia and northwestern Ecuador.

Laterallus melanophaius Rufous-sided Crake: Endemic to South America; widespread and common east of the Andes south to north-central Argentina.

Laterallus spilonotus Galapagos Rail: Endemic to the Galapagos Islands, where locally common.

Laterallus ruber Ruddy Crake: Endemic to Middle America; widespread and common from southern Mexico to Costa Rica.

Laterallus levraudi Rusty-flanked Crake: Endemic to north-central Venezuela (Yaracuy to Miranda); status unknown.

Laterallus leucopyrrhus Red-and-white Crake: Endemic to South America; fairly common within its limited distribution in Paraguay, southeastern Brazil, Uruguay and northeastern Argentina.

Laterallus fasciatus Black-banded Crake: Endemic to South America; scarce and local in southeastern Colombia, eastern Ecuador, northeastern Peru and adjacent western Brazil.

Laterallus viridis Russet-crowned Crake: Endemic to South America; widespread and common east of the Andes from northern Colombia south to southeastern Brazil.

Micropygia schomburgkii Ocellated Crake: Endemic to Neotropical Realm; widely distributed but rather scarce and local in South America east of the Andes to central Brazil. The species has also been recorded in southern Costa Rica.

Coturnicops notata Speckled Crake: Endemic to South America; apparently rare and local in southern Brazil, Paraguay, Uruguay and north and central Argentina; birds recorded during the austral winter in Colombia, Venezuela and Guyana may be migrants from the south.

Coturnicops noveboracensis Yellow Rail: Mainly extralimital; the subspecies endemic to the highlands of Mexico (*C. n. goldmani*) is scarce and local, and possibly endangered. *C. n. goldmani*) is listed in the 1981 edition of the ICBP Bird Red Data Book as indeterminate.

Neocrex colombianus Colombian Crake: Endemic to Neotropical Realm; scarce and local within its limited distribution in eastern Panama, northern and western Colombia and northwestern Ecuador.

Neocrex erythrops Paint-billed Crake: Endemic to South America; widespread and locally fairly common from Venezuela and eastern Colombia south to coastal Peru, northern Argentina and eastern Brazil. Also locally common in the Galapagos Islands.

Porphyriops melanops Spot-flanked Gallinule: Endemic to South America; widespread and common from southern Argentina and Chile north to northern Chile, eastern Bolivia and northeastern Brazil; *P. m. bogotensis*, endemic to the Colombian Andes, is locally common.

Gallinula chloropus Common Gallinule: Widespread and common from Mexico and the Caribbean south to northern Chile and central Argentina.

Porphyrula martinica Purple Gallinule: Widespread and common from Mexico and the Caribbean south to Peru and central Argentina; vagrant to Chile.

Porphyrula flavirostris Azure Gallinule: Endemic to South America; widespread and fairly common east of the Andes from the Orinoco to Paraguay and extreme northern Argentina. Recently recorded in Trinidad.

Fulica americana American Coot: Common resident in Mexico, Guatemala, the Bahamas, the Greater Antilles and the Andes south to northern Chile and Argentina; common winter visitor throughout Mexico, Central America and the northern Caribbean. There is a tiny breeding population in Bermuda. An average of 937,000 was recorded in Mexico in the January counts of 1978-1982.

Fulica (americana) ardesiaca Slate-colored Coot: Apparently only a colour phase of *F. americana*; endemic to South America; common in the Andes from southern Colombia (Nariño) to northern Chile, and in coastal Peru.

Fulica caribaea Caribbean Coot: Endemic to Neotropical Realm; widely distributed but local and rather scarce in the Caribbean and northwestern Venezuela; vagrant to Trinidad. Hybridizes with *F. americana* in some areas (e.g. in the U.S. Virgin Islands).

Fulica armillata Red-gartered Coot: Endemic to South America; widespread and common in the south, extending north to central Chile, Paraguay and southeastern Brazil.

Fulica leucoptera White-winged Coot: Endemic to South America; widespread and common in the south, extending north to northern Chile, eastern Bolivia and southeastern Brazil.

Fulica rufifrons Red-fronted Coot: Endemic to South America; widespread and fairly common in the south, extending north to extreme southern Peru, northern Argentina and southeastern Brazil.

Fulica gigantea Giant Coot: Endemic to South America; common within its restricted distribution in the high Andes of central and southern Peru, Bolivia, northern Chile and extreme northwestern Argentina (Jujuy).

Fulica cornuta Horned Coot: Endemic to South America; locally fairly common within its very restricted distribution in the high Andes of southern Bolivia, northern Chile and northwestern Argentina. Listed in the 1981 edition of the ICBP Bird Red Data Book as rare.

Heliornithidae

Heliornis fulica Sungrebe: Endemic to Neotropical Realm; widespread and fairly common in tropical regions of Mexico, Central America and South America west of the Andes south to western Ecuador and east of the Andes south to Paraguay, extreme northeastern Argentina (Misiones) and southeastern Brazil.

Eurypygidae

Eurypyga helias Sunbittern: Endemic to Neotropical Realm; widespread and fairly common in humid tropical regions from extreme eastern Mexico along the Caribbean slope of Central America to western Colombia and Ecuador, and east of the Andes south to central Brazil.

Jacanidae

Jacana spinosa Northern Jacana: Widespread and common in the lowlands of Mexico, Central America (east to western Panama) and the Greater Antilles.

Jacana jacana Wattled Jacana: Endemic to Neotropical Realm; widespread and common in central and eastern Panama, and South America west of the Andes south to northern Perú and east of the Andes south to central Argentina; vagrant to Chile.

Rostratulidae

Nycticryphes semicollaris South American Painted Snipe: Endemic to South America; locally fairly common from central Chile and central Argentina to southern Paraguay and southeastern Brazil.

Haematopodidae

Haematopus palliatus American Oystercatcher: Locally fairly common on coasts throughout the region except in the extreme south. The small population resident in the Galapagos Islands is thought to number less than 100 birds.

Haematopus bachmani Black Oystercatcher: Mainly extralimital; fairly common resident in northwestern Mexico.

Haematopus leucopodus Magellanic Oystercatcher: Endemic to South America; common within its limited distribution in southern Argentina, southern Chile and the Falkland Islands.

Haematopus ater Blackish Oystercatcher: Endemic to South America; fairly common on the coasts of Peru, Chile, Argentina and the Falkland Islands.

Charadriidae

Vanellus vanellus Lapwing: Extralimital; vagrant from the Old World.

Vanellus chilensis Southern Lapwing: Endemic to Neotropical Realm; rather scarce and local in Panama and northwestern Colombia; widespread and common east of the Andes and in southern South America.

Vanellus resplendens Andean Lapwing: Endemic to South America; widespread and common in the Andes from southern Colombia to northern Chile and Argentina.

Hoploxypterus cayanus Pied Lapwing: Endemic to South America; widespread and fairly common east of the Andes south to Paraguay and extreme northern Argentina.

Pluvialis dominica Lesser Golden Plover: Common passage migrant and winter visitor from the Nearctic, wintering from central Peru and southeastern Brazil to central Argentina.

Pluvialis squatarola Black-bellied (Grey) Plover: Common winter visitor from the Nearctic; widespread along coasts, but rather scarce on the Atlantic coast south of northeastern Brazil.

Charadrius hiaticula Ringed Plover: Extralimital; vagrant from the Old World.

Charadrius semipalmatus Semipalmated Plover: Common winter visitor from the Nearctic; widespread along coasts south to northern Chile and southern Brazil; very scarce in Argentina.

Charadrius wilsonius Thick-billed (Wilson's) Plover: Fairly common resident and winter visitor on coasts of Mexico, Central America, the Caribbean and northern South America south to northern Peru and east to northeastern Brazil.

Charadrius vociferus Killdeer: Common resident in Mexico, the Bahamas, the Greater Antilles and coastal Peru; common winter visitor from the Nearctic to coasts of Central America, Colombia, Ecuador, the Netherlands Antilles (Aruba) and occasionally Venezuela. Occasional visitor to northern Chile.

Charadrius melodus Piping Plover: Mainly extralimital; scarce winter visitor from the Nearctic to northern Mexico, Bermuda and the northern Caribbean. Vagrant to Ecuador.

Charadrius alexandrinus Snowy Plover: Locally fairly common resident on the coast of Mexico, in the Bahamas and Greater Antilles, on islands off the Venezuelan coast (including the Netherlands Antilles), and on the coast of Peru south to central Chile.

Charadrius collaris Collared Plover: Endemic to Neotropical Realm; widespread and common in southern Mexico, in much of Central America, and in South America west of the Andes to northern Peru and in central Chile, and east of the Andes to central Argentina.

Charadrius alticola Puna Plover: Endemic to South America; fairly common within its limited distribution in the high Andes of Peru, Bolivia, northern Chile and northern Argentina.

Charadrius falklandicus Two-banded Plover: Endemic to South America; common breeding bird on the coasts of southern and central Chile and Argentina, and in the Falkland Islands, wintering north to northern Chile, Uruguay and southeastern Brazil.

Charadrius modestus Rufous-chested Dotterel: Endemic to South America; breeding in southern Chile, extreme southern Argentina and the Falkland Islands, and wintering north to north-central Chile, Uruguay and southeastern Brazil (Rio Grande do Sul).

Charadrius montanus Mountain Plover: Mainly extralimital; winter visitor from the Nearctic to northern Mexico.

Eudromias ruficollis Tawny-throated Dotterel: Endemic to South America; breeding locally in the lowlands of coastal Peru and southern Argentina, and commonly in the Andes from southern Peru to southern Chile, and in the Falkland Islands; winters north to southwestern Ecuador, Uruguay and southeastern Brazil.

Pluvianellus socialis Magellanic Plover: Endemic to South America; fairly common within its very restricted range in southern Argentina (Santa Cruz and Tierra del Fuego) and the extreme south of Chile; occurs north in winter to the coast of Chubut.

Phegornis mitchellii Diademed Sandpiper-Plover: Endemic to South America; widely distributed but scarce in the high Andes from central Peru to south-central Chile and Agentina (Chubut).

Scolopacidae

Limosa haemastica Hudsonian Godwit: Uncommon passage migrant and winter visitor from the Nearctic, wintering in southern South America mainly on the coasts of southern Argentina and Chile. The total population may number less than 20,000 birds.

Limosa fedoa Marbled Godwit: Fairly common winter visitor from the Nearctic to Mexico and Central America; scarce winter visitor to the Caribbean and northern South America, south occasionally to Peru.

Numenius phaeopus Whimbrel: Common winter visitor from the Nearctic; widespread along coasts.

Numenius borealis Eskimo Curlew: Presumably still a very rare winter visitor from the Neactic to southern South America, but there have been no records of wintering birds in recent years. The species is on the verge of extinction; it was listed in the 1981 edition of the ICBP Bird Red Data Book as endangered.

Numenius arquata Eurasian Curlew: Extralimital; vagrant from the Old World to Bermuda.

Numenius americanus Long-billed Curlew: Mainly extralimital; winter visitor from the Nearctic to Mexico and Guatemala; occasional in Belize.

Bartramia longicauda Upland Sandpiper: Fairly common passage migrant and winter visitor from the Nearctic, wintering in southern Brazil, Paraguay, Uruguay and northern and central Argentina.

Tringa erythropus Spotted Redshank: Extralimital; vagrant from the Old World.

Tringa nebularia Greenshank: Extralimital; vagrant from the Old World to Bermuda.

Tringa melanoleuca Greater Yellowlegs: Common winter visitor from the Nearctic, occurring throughout the region.

Tringa flavipes Lesser Yellowlegs: Common winter visitor from the Nearctic, occurring throughout the region.

Tringa solitaria Solitary Sandpiper: Common winter visitor from the Nearctic; widespread; in South America mainly east of the Andes south to central Argentina, rarely on the Pacific coast south to northern Chile.

Tringa glareola Wood Sandpiper: Extralimital; vagrant from the Old World.

Catoptrophorus semipalmatus Willet: Locally fairly common resident in the Caribbean; common winter visitor from the Nearctic to Mexico, Central America, the Caribbean and South America south to northern Chile and northeastern Brazil; occasional in southeastern Brazil.

Actitis macularia Spotted Sandpiper: Common winter visitor from the Nearctic; widespread south to southern Peru, Uruguay and northern Argentina; vagrant to Chile.

Heteroscelus incanus Wandering Tattler: Mainly extralimital; scarce winter visitor from the Nearctic to the Pacific coast and offshore islands; common winter visitor to the Galapagos Islands.

Arenaria interpres Ruddy Turnstone: Common winter visitor from the Nearctic, occurring along coasts throughout the region.

Arenaria melanocephala Black Turnstone: Mainly extralimital; winter visitor from the Neactic to northwestern Mexico.

Scolopax minor American Woodcock: Extralimital; vagrant from the Nearctic to Bermuda.

Gallinago gallinago Common Snipe: Common winter visitor from the Nearctic to Mexico, Central America, the Caribbean and northern South America; a local resident in northern Mexico.

Gallinago (gallinago) paraguaiae South American Snipe: Endemic to South America; widespread and fairly common east of the Andes and in the south.

Gallinago andina Puna Snipe: Endemic to South America; fairly common within its limited distribution in the High Andes from central Peru to northern Chile and northwestern Argentina.

Gallinago nobilis Noble Snipe: Endemic to South America; fairly common within its limited distribution in the Andes of Ecuador, Colombia and extreme western Venezuela.

Gallinago undulata Giant Snipe: Endemic to South America; widely distributed but rather scarce east of the Andes from Colombia and Venezuela to Paraguay and southeastern Brazil.

Gallinago imperialis Banded Snipe: Endemic to South America; until recently known only from two specimens taken in the Andes of Colombia and one specimen from the Andes of southeastern Peru, but now known to occur widely in the high Andes of Peru, and presumably occurs in Ecuador.

Gallinago stricklandii Cordilleran Snipe: Endemic to South America; *G. s. jamesoni* is widespread and common in the Andes from Venezuela and Colombia to Bolivia; the nominate subspecies is rather scarce and local in southern Chile, southern Argentina (Tierra del Fuego) and the Falkland Islands.

Lymnocryptes minima Jack Snipe: Extralimital; vagrant from the Old World.

Limnodromus griseus Short-billed Dowitcher: Common winter visitor from the Nearctic to Mexico, Central America, the Caribbean and South America south to Peru and northeastern Brazil.

Limnodromus scolopaceus Long-billed Dowitcher: Mainly extralimital; winter visitor from the Nearctic to Mexico; scarce winter visitor to Central America and the Caribbean; vagrant to Colombia.

Aphriza virgata Surfbird: Common winter visitor from the Nearctic to the Pacific coast of Mexico and South America south to southern Chile.

Calidris canutus Red Knot: Fairly common passage migrant and winter visitor from the Nearctic, wintering mainly in southern Argentina, particularly Tierra del Fuego. The total flyway population is estimated at 250,000 birds.

Calidris alba Sanderling: Common winter visitor from the Nearctic, occurring on sandy coasts throughout the region; particularly abundant in southern Peru and northern Chile.

Calidris pusilla Semipalmated Sandpiper: Common passage migrant and winter visitor from the Nearctic, wintering mainly along the Atlantic coast of South America to eastern Brazil, and in small numbers on the Pacific coast south to extreme northern Chile. Concentrations of several million birds have been recorded on the coast of Suriname.

Calidris mauri Western Sandpiper: Common passage migrant and winter visitor from the Nearctic, wintering mainly along the Pacific coast of Mexico, Central America and northern South America, and much less commonly on the Atlantic coast to the Guianas and northern Brazil.

Calidris minutilla Least Sandpiper: Common winter visitor from the Nearctic; widespread along both coasts south to Peru and eastern Brazil.

Calidris fuscicollis White-rumped Sandpiper: Common passage migrant and winter visitor from the Nearctic, wintering mainly in southern Brazil, Uruguay, Argentina and the Falkland Islands.

Calidris bairdii Baird's Sandpiper: Fairly common passage migrant and winter visitor from the Nearctic, wintering in the Andes of Peru, Bolivia, northern Chile and northwestern Argentina, and on the coasts of southern Chile and Argentina.

Calidris melanotos Pectoral Sandpiper: Common passage migrant and winter visitor from the Nearctic, wintering mainly in the central Andes and southern South America.

Calidris ptilocnemis Rock Sandpiper: Extralimital; scarce winter visitor from the Nearctic to northwestern Mexico.

Calidris alpina Dunlin: Mainly extralimital; winter visitor from the Nearctic to northwestern Mexico; vagrant to Central and South America.

Calidris ferruginea Curlew Sandpiper: Extralimital; vagrant from the Old World.

Micropalama himantopus Stilt Sandpiper: Common passage migrant and winter visitor from the Nearctic, wintering mainly from Bolivia, Paraguay and southern Brazil south to central Argentina.

Tryngites subruficollis Buff-breasted Sandpiper: Fairly common passage migrant and winter visitor from the Nearctic, wintering mainly in southeastern Brazil, Paraguay, Uruguay and northern Argentina.

Philomachus pugnax Ruff: Extralimital; vagrant from the Old World.

Recurvirostridae

Himantopus himantopus (mexicanus) Common (Black-necked) Stilt: Widespread and locally common in Mexico, Central America, the Caribbean and South America south to south-central Argentina and Chile. Also fairly common in the Galapagos Islands.

Recurvirostra americana American Avocet: Mainly extralimital; winter visitor from the Nearctic to Mexico and Guatemala; vagrant to the northern Caribbean.

Recurvirostra andina Andean Avocet: Endemic to South America; rather scarce and local within its limited distribution in the high Andes of southern Peru, Bolivia, northern Chile and northwestern Argentina.

Phalaropodidae

Phalaropus fulicarius Red (Grey) Phalarope: Common winter visitor from the Nearctic to the Pacific off South America; regular on spring passage in Bermuda.

Steganopus tricolor Wilson's Phalarope: Common passage migrant and winter visitor from the Nearctic, wintering in the lowlands and Andes from Peru and Paraguay south to central Argentina and Chile.

Lobipes lobatus Northern (Red-necked) Phalarope: Fairly common winter visitor from the Nearctic to the Pacific off South America; very common at times in the Galapagos Islands.

Burhinidae

Burhinus bistriatus Double-striped Thick-knee: Endemic to Neotropical Realm; locally fairly common on the arid Pacific slope of southern Mexico and Central America, and in Hispaniola, northern Colombia, northern Venezuela, Guyana and extreme northern Brazil.

Burhinus superciliaris Peruvian Thick-knee: Endemic to South America; fairly common within its limited distribution in the arid coastal zone of southern Ecuador and Peru; occasional in extreme northern Chile, but not known to breed there.

Thinocoridae

Attagis gayi Rufous-bellied Seedsnipe: Endemic to South America; widely distributed but rather scarce in the high Andes from Ecuador south to the Straits of Magellan.

Attagis malouinus White-bellied Seedsnipe: Endemic to South America; scarce and local within its limited distribution in extreme southern Chile and Argentina (western Rio Negro to Tierra del Fuego).

Thinocorus orbignyianus Grey-breasted Seedsnipe: Endemic to South America; widespread and common in the Andes from Peru south to Tierra del Fuego.

Thinocorus rumicivorus Least Seedsnipe: Endemic to South America; widespread and locally common in the arid coastal zone from southern Ecuador south to northern Chile, in the Andes of Bolivia, northern Chile and northwestern Argentina, and in central and southern Chile and Argentina south to Tierra del Fuego; the southern population winters north to Uruguay.

Laridae

Larus atricilla Laughing Gull: Common resident in the Caribbean and Mexico; common winter visitor from the Nearctic to Mexico, Central America, the Caribbean and coastal South America south to northern Peru and east to the Amazon Delta.

Larus pipixcan Franklin's Gull: Common winter visitor from the Nearctic to the Pacific coast of South America south to southern Chile; occasional east of the Andes in Argentina.

Larus maculipennis Brown-hooded Gull: Endemic to South America; widespread and common from southeastern Brazil and north-central Chile to Tierra del Fuego and the Falkland Islands.
Larus ridibundus Black-headed Gull: Extralimital; vagrant from the Old World.
Larus philadelphia Bonaparte's Gull: Mainly extralimital; winter visitor from the Nearctic to northwestern Mexico; casual winter visitor to the Caribbean and Central America.
Larus minutus Little Gull: Extralimital; vagrant from the Old World to Bermuda.
Larus serranus Andean Gull: Endemic to South America; widespread and common in the Andes from Ecuador to central Chile and northwestern Argentina.
Larus cirrocephalus Grey-hooded Gull: Rather scarce and local on the Pacific coast from Ecuador to southern Peru; locally fairly common from northeastern Brazil south to eastern Bolivia, Paraguay, Uruguay and northern Argentina.
Larus delawarensis Ring-billed Gull: Mainly extralimital; winter visitor from the Nearctic to Mexico and the Caribbean; casual winter visitor to eastern Central America.
Chlidonias hybrida Whiskered Tern: Extralimital; vagrant from the Old World.
Chlidonias leucoptera White-winged Black Tern: Extralimital; vagrant from the Old World.
Chlidonias nigra Black Tern: Common winter visitor from the Nearctic to Mexico, Central America and South America south to northern Peru and east to Suriname; common passage migrant in the Caribbean; vagrant to Argentina and Chile.
Phaetusa simplex Large-billed Tern: Endemic to South America; widespread and common from northern Colombia east of the Andes south to north-central Argentina.
Gelochelidon nilotica Gull-billed Tern: Rather scarce and local breeding bird in northwestern Mexico, the northern Caribbean, western Ecuador, coastal Brazil, Uruguay and northern Argentina; fairly common winter visitor from the Nearctic south through Central America to coastal Peru and the Guianas.
Hydroprogne caspia Caspian Tern: Fairly common winter visitor from the Nearctic to Mexico, Central America, the Caribbean, Colombia and northwestern Venezuela.
Sterna hirundo Common Tern: Common winter visitor from the Nearctic; widespread along coasts.
Sterna hirundinacea South American Tern: Endemic to South America; widespread and common along coasts north to central Peru and east-central Brazil.
Sterna forsteri Forster's Tern: Mainly extralimital; winter visitor from the Nearctic to Mexico and Belize; casual elsewhere in Central America and the Caribbean.
Sterna trudeaui Snowy-crowned Tern: Endemic to South America; fairly common in coastal areas of central and southern Chile, most of Argentina, Uruguay and southeastern Brazil, wintering north to southern Peru.
Sterna superciliaris Yellow-billed Tern: Endemic to South America; widespread and common east of the Andes from Colombia south to Uruguay.
Sterna albifrons (antillarum) Little (Least) Tern: Fairly common breeding bird on both coasts of Mexico and in the Caribbean (including Aruba in the Netherlands Antilles and other islands off the Venezuelan coast); winter visitor to the coast of South America south to northeastern Brazil and Peru.

Rynchopidae

Rynchops niger Black Skimmer: Widespread and common along the coasts and main river systems of Mexico, Central America and South America south to northern Argentina and northern Chile, but not known to breed on the Pacific coast south to Ecuador; occasional at altiplano lakes in Bolivia. Fairly common winter visitor to the Caribbean.